ol. VIII. No. 1, 2, 3. April, 1895. No. 4.

PAVING AND MUNICIPAL ENGINEERING

A MONTHLY MAGAZINE,

DEVOTED TO THE IMPROVEMENT OF CITIES.

ROADS AND STREETS, BRIDGES,
STREET LIGHTING, SEWERS,
WATER WORKS,
STREET RAILWAYS.

PUBLISHED BY
MUNICIPAL ENGINEERING COMPANY
INDIANAPOLIS

Two Dollars Per Year. Single Copies, 25 Cents.

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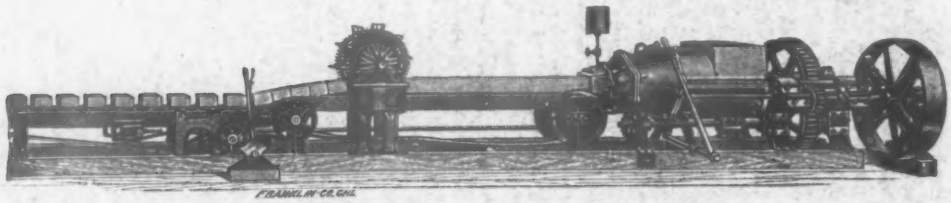

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Paving and Municipal Engineering

VOLUME VIII. APRIL, EIGHTEEN NINETY-FIVE. NUMBER 4.

INJURIOUS MANIPULATION OF ASPHALT.

From a consideration of much that has been written concerning asphalt as a material for paving purposes, it appears that those who have given thought to the subject have confined their study almost entirely to the chemical side of the subject; to the various effects, for better or worse, of different fluxing mixtures or media. While more extensive information in this direction is greatly to be desired, the writer is of the opinion that a greater amount of the defects of many asphalt pavements come from improper manipulation of the asphalt in the process of manufacture than from any deficiencies in the asphalt itself. While it may not be fully determined to the satisfaction of chemists just what should be the best proportions for an asphalt cement, there is no question as to the fact that any asphalt will surely be damaged by overheating, or, to use a shop term, "burning."

The importance of proper melting being so well known and indisputably established, it is strange that city engineers, who are responsible for the quality of the streets made under their supervision, do not give more attention to the character of the manufacturing plants operated by the contractors who propose to do the work of making the pavement. There are great differences in the manner of treating asphalt by various manufacturers, and while it is not to be expected or desired that any municipal authority should have the right to dictate to a contractor as to the character of his plant in detail, he should certainly be enabled to exercise a power to condemn practices well known to be faulty.

A ton of asphalt, for instance, may be melted in one-half an hour, or two hours may be consumed in the melting. In both cases the result will be melted asphalt. But the thing to know is whether the batch which is melted in one-half hour is as good for

paving purposes as that which was melted more slowly. Much carelessness obtains in this matter of melting. Some manufacturers are provided with proper furnaces and kettles and others are very deficient in this respect. A large tank, or kettle, mounted within brick walls, and suspended directly over a hot fire, is not a proper melting appliance. With skillful and intelligent handling it is possible to melt asphalt in this manner without injuring it. But skillful and proper attention is hardly to be expected of the average stoker, and even should he try to fire so evenly and slowly as to insure non-burning, he would soon call down the wrath of the foreman for not getting out the material in sufficient quantities in a given time.

There can never be any assurance that asphalt melted in an arrangement of this sort is not more or less "burned." The writer has seen discarded melting kettles with their heavy sheet-steel bottoms actually burned through and distorted out of all shape, by reason of hot fires concentrated under but a small portion of the available heating surface of the kettle. There can hardly be a question but that much of the material that left these kettles was burned. In a properly constructed furnace the kettles should remain unimpaired forever. Where such improper construction prevails, a city engineer should certanly have the authority to condemn it.

In a proper melting plant the fires should not be allowed to come into direct contact with the kettles. All the available heating surface of the kettle should be utilized; the melting should be not merely at the bottom, but all about the sides and ends. Melting is thus accomplished much more rapidly and with less expense of fuel; further than this, there is a guarantee that the asphalt will not be "burned."

Another practice which to the writer seems reprehensible is the stirring of the melted asphalt by means of a blast of air forced through a perforated pipe, which is moved about by an operator. The effort of the air to gain the surface and escape causes an ebullition which is mistaken for proper mixing, but is in reality merely the pushing aside of the particles of the mixture by the air rising to the surface. It is nonsensical to introduce a blast of comparatively cold air into a mass which one has been at such pains to heat.

Proper mixing can only be accomplished by a mechanical agitator of such construction that all of the constituents of the melted mass shall be thoroughly intermingled and held in suspense until the last possible moment. No asphalt plant is complete without such an agitator, for by its use the mixture can never come to rest and the heavier portions settle to the bottom. It may be kept going night and day, or as long as it contains melted asphalt, requiring no attention whatever.

No inspector can determine with any degree of certainty the condition of asphalt cement when it is delivered upon the street—other than its temperature. For this reason all city authorities who are in charge of street improvements should give due consideration to the character of the processes by which it is produced. It is true that when the asphalt is very badly burned there will be sure signs which will develop in the rolling; but there may be no indication of a lesser degree of burning, although it may be still sufficient to cause imperfect streets—imperfections which will develop later in the shape of cracks and rotten spots.

There is one characteristic of asphalt which, to the writer's knowledge, has not been touched upon by chemists who make its study a specialty. That is its sensitiveness to light when under certain conditions. For years thin solutions of asphalt in benzole have been used in the photographic reproductive printing processes for the purpose of sensitizing plates. When thinly spread upon a plate and dried in a dark room it is extremely sensitive to light. Portions which are exposed to light for a few minutes become insoluble in benzine; other portions, which have been shaded, are still soluble. Whether this characteristic of asphalt cuts any figure in its usefulness for paving purposes I leave to others more skilled in chemistry to decide. It would also be interesting to know whether asphalt which has been "burned" is still soluble. In case it is not soluble why can not a proper test be arrived at in this manner? Different degrees of solubility would indicate different degrees of impairment.

F. A. Hetherington.

F. A. HETHERINGTON, M. E.

SOME TESTS OF PAVING BRICK.

SEVERAL months ago the writer was called upon, with several other engineers, to testify as to the character of some brick paving that had just been laid in a small interior city of New York, and incidentally as to the character of the bricks themselves. The conflicting testimony developed upon this hearing, as to the effect of side-cutting and re-pressing, as compared with each other, and with end-cutting, seemed to call for further information of an exact nature.

At intervals since then he has undertaken the testing of various makes and varieties of paving brick; and in the following tables will be found a summary of the results obtained, and a classification of the bricks tested according to the method of treatment of the raw material.

As to the tests themselves, the bricks to be tested were kept in a steam-heated room for at least two months before being tested to insure the entire evaporation of such moisture as they had absorbed after leaving the kiln. They were then carefully measured and placed in an Olsen 50,000 lb. testing machine for transverse breaking strength. Each brick was tested whole by being placed on edge on parallel knife edges six inches apart and broken by gradual pressure applied through a third bearing edge, parallel to the others, at the middle of the upper edge of the brick. Almost none of the samples broke by spalling through the points of bearing of the lower knife-edges, but broke transversely, and in many cases squarely, with a clean fracture.

The "modulus of rupture," as given in the table, is derived from the formula of mechanics, $M=\frac{R\,I}{e}$, with R=modulus of rupture, I=moment of inertia, e=one-half the depth and M=the moment. Substituting $\frac{1}{2}\ bd^3$ for I, $\frac{1}{2}\ d$ for e and $\frac{1}{4}\ Wl$ for M, the above quotation reduces to $R=\frac{3\ Wl}{2bd^2}$ in which l, b, and d equal length, breadth and depth respectively. In this case l is six inches, and calling bd equal to a, the cross-section, we have $R=\frac{9W}{ad}$.

To determine the specific gravity and the absorption, sound half bricks were used; care was taken to select samples of very

nearly the same weight with one interior surface, hoping, in this way, to eliminate errors resulting from glazing and laminations in the interior. The half-bricks were carefully weighed, on a scale reading to hundredths of pounds, and then immersed in water for forty-eight hours; at the end of which time they were carefully weighed while entirely submerged; then removed from the water, all surface moisture quickly wiped off and the sample re-weighed. The specific gravity was determined by the following formula, $\text{Sp. Gr.} = \frac{W}{W' - W''}$, in which W equals the dry weight, W′ the weight after immersion, and W″ the weight in water.

For the abrasion test cubes were cut from each brick, measuring about 2½ inches on each side, and of very nearly the same weight. Each cube was carefully weighed, and four of them, together with twelve one-inch steel cubes, were put in a tumbler, consisting of a cylinder of iron, 12 inches long and 6 in diameter, which revolved about a horizontal shaft 47½ times per minute. After fifteen minutes they were taken out, re-weighed and replaced, and allowed to tumble for one hour, when they were again taken out and re-weighed. Only the amount abraided during the second tumbling was used in determining the abrasion.

The crushing strength was ascertained by crushing half-bricks on an Olsen 300,000-pound testing machine. The pieces to be crushed were carefully set in a matrix of plaster of Paris on both bearing surfaces. A pressure of three or four tons was applied and allowed to stand for fifteen minutes, to allow the plaster to harden; they were then tested to destruction. Tests were made with several samples of whole brick, but the results were neither uniform nor satisfactory. Some unevenness of the bearing surfaces, or internal strains developed in the process of manufacture or burning, gave results smaller per square inch than when half-bricks were used.

Table I is self-explanatory. Table II gives in consecutive columns the results of the tests. In table III, which is offered with a good deal of diffidence, an attempt has been made to combine the results of the tests so as to arrive at a fairly representative composite value. In combining the tests in the natural order, according to the results in table II, the difficulty is encountered of trying to

unite in a common expression unlike terms, representing unlike values, and giving to each individual test precisely the same value as to every other. In the attempt to avoid this, table III has been arranged. The figures representing specific gravity were taken, arbitrarily of course, as a basis of combination; crushing strength per square inch was divided by 4 and expressed in thousands of pounds; transverse modulus is expressed directly in thousands of pounds; absorption, expressed in percentage, being in inverse proportion to the value as a paving material, its reciprocal is taken, multiplied by 3⅓; in like manner the reciprocal of the abrasion is multiplied by 12½.

Table IV shows the result of this method of combination in comparison with the value as given by each individual test, together with the respective columns of differences. The sums of these columns of differences may represent the relative value of the several tests under the method of combination adopted.

Table V shows the several bricks arranged according to method of manufacture.

The writer is very far from asserting that, as a rule, end-cut brick are superior to side-cut ones; or that side-cut brick are superior to re-pressed ones. But if the samples given in table VI fairly represent their several classes, then the above inference may be drawn.

The discussion of the general results, and the probable reasons therefor, as deduced from an inspection of the bricks tested and from their behavior under the various tests, is, as Mr. Kipling says, "another story," and if entered upon here, would far exceed the limits of this paper. The results are set down as observed, and if a study of these results furnishes the reader with a tithe of the information that their securing furnished the writer, he will be amply repaid.

TABLE I.

No.	Size.	Remarks.
1	2.5 x 4 x 8.5	Side-cut, dark red; homogeneous shale, medium fine.
2	2.5 x 4.2 x 8.5.	Repressed, ditto.
3	2.6 x 4 x 8.3	End-cut, ditto.
4	2.4 x 4 x 8.5	Side-cut, dark brown; coarse granular shale.
5	2.6 x 4 x 9.	Repressed, cream; very fine granular fire-clay.
6	2.6 x 4.2 x 9	Repressed, dark cream; fine, granular, shaly fire-clay.
7	2.5 x 4 x 8.2	Side-cut, dark buff; medium fine, granular shaly fire-clay.

No.	Size.	Remarks.
8	2.3 x 4.3 x 8.8	Repressed, ditto.
9	2.4 x 4.2 x 8.8	Repressed, Paten's shape.
10	2.6 x 4 x 8.5	Side-cut, buff; medium fine, homogeneous shaly fire-clay.
11	2.4 x 4.2 x 8	Repressed.
12	2.3 x 4 x 8.5	Repressed, dark cream; fine granular shale, fire-clay, fine.
13	2.5 x 4.1 x 8.5	Side-cut, red; fine slightly granular shale.
14	2.4 x 4 x 8.4	Side-cut, bronze; granular shale and fire-clay.
15	2.5 x 3.9 x 8.3	End-cut, ditto.
16	2.6 x 4.1 x 8.4	Side-cut, black; fine granular shale.
17	2.3 x 3.8 x 8	Side-cut, greenish buff; very fine, homogeneous clay.
18	2.4 x 3.8 x 8.3	End-cut, ditto.
19	2.4 x 3.8 x 8.3	Ditto, plus 20% fine ground shale.
20	2.3 x 3.8 x 8	Repressed, dark red; coarse, granular shale.
21	2.3 x 3.9 x 8	End-cut, ditto.
22	2.5 x 4.2 x 8.5	Side-cut, dark red; coarse, homogeneous shale; glazed.
23	2.6 x 4 x 8.5	Side-cut, dark brown; fine homogeneous shale.
24	3 x 4 x 8.8	Hallwood block, repressed, grayish brown; fine homogeneous shale.
25	3 x 4 x 9	Hallwood block, repressed, brown coarse granular shale, with some fire-clay; glazed.
26	3 x 4 x 9.2	Hallwood block, dark brown; repressed; coarse granular shale.

TABLE II.

No.	Specific Gravity.	Crushing Strength.	Modulus Trans. Strength.	Absorption Per Cent.	Abrasion Times Trap Rock.
1	2.28	8905	2755	1.67	10.47
2	2.24	7390	2602	3.02	3.31
3	2.27	10740	2685	0.58	3.35
4	2.14	6825	2555	3.17	6.57
5	2.28	9400	2365	0.86	10.84
6	1.95	7410	1805	5.25	8.73
7	2.11	8585	1605	1.69	17.18
8	2.09	4985	1450	5.25	13.18
9	2.12	8095	2010	3.74	14.33
10	2.12	9555	1710	1.69	15.87
11	2.19	5425	2100	1.79	9.31
12	2.09	5165	1585	5.00	9.44
13	2.27	13160	2675	2.33	7.13
14	2.00	12245	1790	3.99	13.77
15	1.96	6555	2005	3.45	8 46
16	2.16	9575	2360	2 61	11.18
17	2.18	11440	3175	3.99	7.19
18	2.28	12340	3070	1.11	4.43
19	2.23	13750	5005	1.52	0.87
20	2.13	8640	2740	3.82	7.45
21	2.17	3405	1930	0.99	13.59
22	2.22	8215	2235	2.48	7.21
23	2.22	14650	3170	0.28	1.66
24	2.13	7085	3425	1.58	7.53
25	2.18	4125	2155	0.79	6.61
26	2.14	8210	3375	2.46	12.14
27	2.65	Granite.		0.13	1.79
28	2.93	Trap Rock.		0.52	1.00

TABLE III.

No.	Specific Gravity.	Cr'sh. Str. in 1000s÷4.	Mod. Tr. Str. in 1000s.	Absorp. Recip.×$\frac{10}{3}$	Abrasion Recip.×$\frac{100}{8}$	Composite Rating.
1	2.28	2.23	2.76	2.00	1.20	10.47
2	2.24	1.85	2.70	1.10	3.28	11.67
3	2.27	2.69	2.69	5.75	2.88	16.38
4	2.14	1.76	2.56	1.05	1.90	9.41
5	2.28	2.35	2.37	3.88	1.15	12.03
6	1.95	1.85	1.81	0.64	1.44	7.69
7	2.11	2.15	1.61	1.97	0.73	8.57
8	2.09	1.25	1.45	0.64	0.95	6.38
9	2.12	2.02	2.01	0.89	0.88	7.92
10	2.12	2.39	1.71	1.97	0.79	8.90
11	2.19	1.38	2.10	1.86	1.34	8.85
12	2.09	1.29	1.59	0.67	1.33	6.97
13	2.27	3.29	2.68	1.43	1.75	11.42
14	2.00	3.06	1.79	0.84	0.91	8.60
15	1.96	1.64	2.01	0.97	1.48	8.06
16	2.16	2.39	2.36	1.28	1.13	9.32
17	2.18	2.86	3.18	0.85	1.74	10.77
18	2.28	3.09	3.07	3.00	2.83	14.27
19	2.23	3.41	5.01	2.19	14.39	27.26
20	2.13	2.16	2.74	0.87	1.68	9.58
21	2.17	0.85	1.93	3.37	0.93	9.25
22	2.22	2.05	2.24	1.34	1.74	9.59
23	2.22	3.66	3.17	11.91	7.53	28.49
24	2.13	1.80	3.43	2.11	1.66	11.13
25	2.18	1.03	2.16	4.22	1.89	11.48
26	2.14	2.05	3.38	1.36	1.04	9.97
Mean,	2.15	2.21	2.46	2.23	2.27	11.32

TABLE IV.

Composite No. Rank.	No. of Maker.	Spec. Grav.	Diff.	Crush Str.	Diff.	M. Tr. Str.	Diff.	Abs.	Diff.	Abr.	Diff.
1	23	8	7	1	0	5	4	1	0	2	1
2	19	7	5	2	0	1	1	7	5	1	1
3	3	5	2	7	4	10	7	2	1	4	1
4	18	3	1	4	0	6	2	6	2	5	1
5	5	2	3	10	5	13	8	4	1	18	13
6	2	6	0	17	11	9	3	17	11	3	3
7	25	12	5	2	18	16	9	3	4	7	0
8	13	4	4	3	5	11	3	13	5	8	0
9	24	17	8	19	10	2	7	8	1	12	3
10	17	11	1	6	4	4	6	22	12	9	1
11	1	1	10	11	0	7	4	9	2	17	6
12	26	16	4	15	3	3	9	14	2	20	8
13	22	9	4	14	1	15	2	15	2	10	3
14	20	18	4	12	2	8	6	21	7	11	3
15	4	15	0	20	5	12	3	18	3	6	9
16	16	14	2	8	8	14	2	16	0	19	3
17	21	13	4	26	9	20	3	5	12	22	5
18	10	20	2	0	9	23	5	11	7	25	7
19	11	10	9	22	3	17	2	12	7	15	4
20	14	24	4	5	15	22	2	23	3	23	3
21	7	21	0	13	8	24	3	10	11	26	5
22	15	25	3	21	1	19	3	19	3	13	9
23	8	19	4	16	7	18	5	20	3	24	1
24	6	26	2	18	6	21	3	25	1	14	10
25	12	22	3	23	2	25	0	24	1	16	9
26	8	23	3	24	2	26	0	26	0	21	5
Sums of Differences,			94		138		102		106		114

TABLE V.

Side-Cut Brick.

No. Rank.	No. of Maker.	Specific Gravity.	Crushing Strength.	Trans. Modulus.	Absorp.	Abras.	Composite Rating.
1	23	2.22	3.66	3.17	11.91	7.53	28.49
2	13	2.27	3.29	2.68	1.43	1.75	11.42
3	17	2.18	2.86	3.18	0.85	1.74	10.77
4	1	2.28	2.23	2.76	2.00	1.20	10.47
5	22	2.22	2.05	2.24	1.34	1.74	9.59
6	4	2.14	1.76	2.56	1.05	1.90	9.41
7	16	2.16	2.39	2.36	1.28	1.13	9.32
8	10	2.12	2.39	1.71	1.92	0.79	8.90
9	14	2.00	3.06	1.79	0.84	0.91	8.60
10	7	2.11	2.15	1.61	1.97	0.75	18.57
						Mean	11.55

Repressed Brick.

1	5	2.28	2.35	2.37	3.88	1.15	12.03
2	2	2.24	1.85	2.70	1.10	3.28	11.67
3	25	2.18	1.03	2.16	4.22	1.89	11.18
4	24	2.13	1.80	3.43	2.11	1.66	11.13
5	26	2.14	2.05	3.38	1.36	1.04	9.97
6	20	2.13	2.16	2.74	0.87	1.68	9.58
7	11	2.19	1.38	2.10	1.86	1.34	8.85
8	9	2.12	2.02	2.01	0.89	0.88	7.92
9	6	1.95	1.85	1.81	0.64	1.44	7.69
10	12	2.09	1.29	1.59	0.67	1.33	6.97
11	8	2.09	1.25	1.45	0.64	0.95	6.38
							9.42

End-Cut Brick.

1	19	2.23	3.44	5.01	2.19	14.39	27.26
2	3	2.27	2.69	2.69	5.75	2.88	16.38
3	18	2.28	3.09	3.07	3.00	2.83	14.27
4	20	2.17	0.85	1.93	3.37	0.93	9.25
5	14	1.96	1.64	2.01	0.97	1.48	8.06
						Mean	15.04

JAMES W. REED, C. E., was born in Warrensburg, N. Y., in 1861, and was educated at the Warrensburg Academy and at Cornell University, graduating from the latter in 1883 as a civil engineer.

Mr. Reed's first position was as a sanitary engineer in Philadelphia, Pa.; in 1884 he was a United States Assistant Engineer on the lower Mississippi; and since 1885 he has devoted himself to private practice as a sanitary and hydraulic engineer. Mr. Reed designed and built a complete sewer system for Cape May Point, N. J., and designed sewer systems for Atlantic City and Trenton, N. J., and for Glens Falls, N. Y. He has also made plans for the development and utilization of water-power in several places. One year ago Mr. Reed located at Ithaca, N. Y., where the very extensive laboratories, and the complete library of Cornell University afford ample opportunities for experiment and research in sanitation and hydraulics.

HOW TO PREVENT ELECTROLYSIS OF GAS AND WATER PIPES.

THE destruction of gas, water and other metallic underground pipes by electric currents has caused considerable trouble in Saginaw, Mich., for the last few years. The presence of this destructive agent became apparent soon after the electric cars were put in operation, in the summer of 1889. The main pipes were not affected to any great extent, but the water and gas service connections suffered much, being totally destroyed in from two to four months in the vicinity of the power station of the street railway company.

Nothing, beyond a few experiments on individual pipes, was done to prevent the destruction of pipes by electricity until a few months ago. Washington avenue, the main thoroughfare from the city hall down town, traversed by a double track electric street railway, and on which the railway power station is located, was repaved for a distance of nearly one mile on a concrete foundation, necessitating systematic, prompt and effective action to prevent the continual tearing up of the concrete to repair and replace destroyed pipes. Early in the season observations were commenced to determine the extent of this electrolytic action, commonly known as electrolysis.

The voltameter showed currents to be passing over pipes in all parts of the city on streets traversed by electric street railways, but in the examination of pipes taken from near extremities of railway lines, deterioration was detected in a very slight degree only. A "danger district" was finally decided upon, extending about half a mile either way from the power station along Washington avenue.

In our street railway system the out-going current is conveyed by the overhead trolley wire, while the current is returned by way of the tracks and supplementary wires. Electrolysis is, in most cases, caused in the following manner: Owing to a poor track construction, consequently a high resistance return medium, electricity in large quantities escapes to the earth. The grounded portion of the current again divides a portion, the quantity depending upon the relative carrying capacity of the earth and the pipes and determined by Ohm's law, $C=\frac{E}{R}$, taking to the water and gas mains, as a means of returning to the power station. The current—sometimes

increasing, sometimes decreasing, according to the nature and condition of the soil through which it passes,—follows the pipes until conditions are favorable for its return to the track system, which, in our case, did not occur until the current approached the power station where the supplementary and track wires leave the earth to return to the dynamo. In leaving the pipes and returning to the earth preparatory to taking to the track and supplementary wires, to be returned to the power station, the current overcomes considerable resistance. Whenever a current of electricity passes through high resistance in the passage from one conductor to another, small particles of the first conductor are carried with the current, thus causing the chemical decomposition known as electrolysis. The rapidity with which a substance is decomposed by this action depends upon the current strength, substance acted upon and resistance overcome in the passage. The destruction of service pipes in preference to the mains, I attribute to the tendency of electricity, in the passage from one conductor to another, to leave the first conductor from a point. This tendency causes the current to flow to the smaller service connection pipes before returning to the earth and tracks, whose surfaces more nearly approach a point in form than does the flatter surface of the main.

To prevent electrolysis of pipes, the most certain way would be to insulate the current from the ground completely, but at present this method is not practicably available. To reduce the current entering the earth to a minimum, and leading the grounded current back to the return conductor by means of metallic conductors, is the method generally used. By increasing the carrying capacity of the ground system to several times that of the overhead trolly-wire (in Saginaw it was made about five times greater), the grounded portion of the return current can be reduced to a minimum. Now, if the current that follows along the pipes can be removed quietly by means of metallic conductors, without overcoming resistance in the passage, the cure has evidently been effected.

Two methods, varying but slightly in their details, are advanced for the removal of the current from the pipes. Both provide for the making of connections with the water and gas mains with copper wire of sufficient carrying capacity, the size of such wires depending upon the strength of current to be conveyed, and the fre-

quency with which such connections are made. While one method provides for the connections of such wires directly with the track system, the other recommends a connection with a special overhead return feeder. The idea of the first method is, no doubt, based on an economical accomplishment of the object without the erection of another eye-sore to the public in the shape of a second overhead wire, and is objected to on the ground that should the carrying capacity of the track system be impaired by the breaking or disabling of bond wires, or otherwise, the current would be conducted directly to the pipes by metallic conductors, in which case the current would be considerably stronger than it would be under similar conditions of the track system, if the current were conducted to the pipes by means of the earth, as would be the case if the second method were used, and unless excellent facilities for the removal of the current from the pipes were afforded at the power station, the danger of electrolysis of underground pipes is apparent.

In the first method, in which equalization of flow of electricity between the tracks and pipes is the principal achievement, the entire current on the pipes is left to be removed at nearly one time at the power station, while in the second method, at certain points the pipes are relieved of a considerable proportion of the current, which is carried to an overhead return wire, equalizing the flow between pipes and return wire and removing a portion of the current without any opportunity of returning to the pipes or ground. The second system is the one adopted in Saginaw. Connections of mains with overhead return feeder were made with No. 00 copper wire at intervals of 600 feet at the power station and increasing to 1,200 feet apart.

Too great care can not be used to secure good wiring of the track system. A few broken bond wires or imperfect connections will impair the working of the system and cause electrolysis of underground pipes at such places. All connections of wires with rails, water or gas pipes, or other wires, should be made in the best possible manner and well covered with solder, to prevent the accumulation of dirt or rust directly upon the connection, thus increasing the resistance of the union. The statement that the weakest link determines the strength of a chain holds no truer than does the statement that the carrying capacity of a conductor of electric-

ity is determined by the carrying capacity of the weakest point of the conductor.

An opening was left in the concrete over a service connection at the power station, to permit of the examination of the pipe from time to time, so as to give us an idea as to the degree of completeness with which the evil has been remedied. During the early part of October, 1894, the pipe was uncovered, after having been in the ground over three months, and slight signs of deterioration were perceptible, which we attribute to the fact that the wires from the track to the dynamo were not increased to the intended capacity. This was done immediately after this examination, and I think the next examination will result more favorably.

UDO HESSE.

Udo Hesse.

THE DUTIES OF A CITY ENGINEER.

IT IS a matter of frequent comment that the population of cities is increasing with great rapidity; this is doubtless owing to the better appreciation of the fact that concerted action and a division of expenses will give comforts and conveniences in much larger measure than would be possible without them. It is the province of the municipal engineer to help a community receive the full benefits of aggregation, that is to say, the maximum of comforts and conveniences at the minimum of cost. It is also the duty of the municipal engineer to guard against the unsanitary conditions arising from density of population.

To many engineers, the nomadic life that they are apt to lead during the first few years of their practice becomes at length distasteful and they wish to settle in some fixed habitation; to these municipal engineering may seem an inviting field. To a young engineer starting in practice, however, there are many reasons why it is unwise to settle down in a city engineer's office until he shall have attained a more extended experience and the better knowledge of engineering practice and procedure from other lines of work.

Unfortunately, municipal engagements in the past have frequently been of a temporary and uncertain character, with consequent effects on the preparation which engineers have felt warranted in making for this work. There are signs, however, that the tenure of office in municipalities is tending towards greater permanence and security, as our citizens become convinced that there is no logical relation between national or state politics and city government. Whether a person intends to devote his energies to municipal engineering or to practice in other fields, it will be well for him before engaging in municipal work to prepare for such employment by familiarizing himself with the work necessarily thrown into the hands of the city engineer. He should be skilled as a surveyor, he should understand what precise work is, how to measure base lines and to measure angles with precision. When circumstances render it necessary he should be able to determine an azimuth from simple astronomical observations.

The city engineer should have a good knowledge of the degree of precision that may be expected in work of various kinds, and made with various instruments, he would be benefited by a study of the laws of the propagation of error. For information of this character I do not know of any single work on surveying and allied topics that is better worthy of careful study than Jordan's Vermessungskunde. It is, indeed, a library in itself; its literary style is very simple and it can be easily translated by anyone having a slight knowledge of German and a little perseverance. It is very much to be desired that those employed in the city engineer's office should all be good draughtsmen; their ideas and the results of their work must constantly be put in shape for others to understand and use; hence the importance of being able to make clear and accurate drawings as well as neat and legible notes of all kinds.

A good knowledge of constructive work in general should be sought after, especial attention being paid to all that pertains to the construction of sewers and pavements. In many cities an extensive knowledge of the details of construction and maintenance of water-works is essential; the same is true regarding the construction of bridges, although both of these studies are specialties in which it is often desirable that the city engineer, before undertaking important works, should seek advice from those who are devot-

ing their lives to those branches of engineering. Frequently a knowledge of the principles of architecture is desirable, especially as regards the constructive details. In regard to the artistic side of this profession, the engineer would do well to always consult an architect of experience. The same general considerations are true as regards the planning and maintenance of parks, especially if these are to be large and important ones.

It is a good rule for the city engineer to prepare his specifications as if he expected to have some sharp and unscrupulous contractor undertake the work. Sooner or later this will happen, and the engineer can never foresee when the time will come. City contracts are generally let to the lowest bidder, or else all bids are rejected. This plan may seem an unfortunate one and not well adapted to secure the best work, but it is the general opinion that this is the best way, and that it gives fewer openings for dishonest dealings on the part of the city officials. Whatever opinion the city engineer may have about the method of letting the work, he will not make any mistake if he always keeps in mind, when preparing his specifications, the possibility of the work being awarded to the most objectionable contractor he may know. The specifications should be so framed that it will be to the interest of the contractor to do what the engineer wishes to have him do. This requirement is not easily fulfilled.

The engineer should always be perfectly fair towards the contractor. He should fix prices in his specifications for all work that may be possibly required, but which can not be definitely estimated and fixed in the approximate quantities; the prices should be sufficient to give the contractor a reasonable profit and no more. A price should be fixed for every possible contingency; there should be no claims for extra work; very often the engineer is precluded from making allowances for extra work by law, and such allowances will open him to hostile criticism in any event.

The power of employing and of removing inspectors should be vested in the city engineer, absolutely. This is now the case in Albany, a charter amendment to this effect having been obtained several years ago.

From time to time the engineer will be called upon to measure up the work and make estimates of the amount done, so that the

contractor may receive partial payments, or, as is usually done, certificates of indebtedness. On the completion of the entire work, the final and exact estimate of all the work done must be made by the engineer. In all of this work scrupulous care is needed, and it is to the credit of city engineers as a class that the instances in which they have been accused of any unfairness in such measurements are very rare indeed.

The city engineer is next called upon to make the apportionment map, which must show accurately all the pieces of property that are to be assessed for benefits derived from the improvement. In some cities these maps are sometimes quite extensive, particularly in the case of assessments for large sewers, as with these the cost must be spread over the entire water-shed. Attention may be called to the necessity of having a standard measure; the city engineer is often called on to testify in court and, by a state law, his testimony regarding his measurements may be rejected unless his tape or chain can be shown to have been compared with an official standard. At Albany the city engineer has a standard tape that has been compared at the Bureau of Weights and Measures in Washington, with the mural standard there kept. I would advise every city engineer to send a tape to Washington for comparison and a certificate as to its length; such a tape should be kept for no other use than comparison of those in constant use in the field.

I would advise every city engineer to proceed with the execution of a comprehensive city map, whether he sees any immediate use for it or not. Generally he will find the existing maps very defective and that it is impossible to unite them on account of lack of system in making the original surveys. If the existing maps are very bad it would be better to have a party devote its entire time to the work of mapping, so that the results may be obtainable as soon as possible. If the city is large the work required to map it will be almost unlimited, and the work should be carried on most systematically in all respects in order that the great accumulations of notes may be always convenient for reference.

A city map should always be based on a triangulation; if possible, the state or government triangulations should serve as the original basis. If this is not possible several base lines should be measured, using the methods that are so fully described in John-

son's Surveying. Generally the city engineer will be able to measure his base lines with a degree of precision considerably greater than he can retain in his triangulation, if he uses an ordinary engineer's transit for measuring the angles; if he is compelled to do this he will, therefore, do well to rely on several measured base lines at different parts of his triangulation, if he can manage to lay out such base lines with good connections with the triangulation. It is not practicable to make the measurement of the traverse lines with the same degree of precision that exists in the base line measurements. I should therefore recommend the measurement of the base line, or of one or more sides of the triangulation, with the same care and with the same methods that are to be employed on the traverse lines, then, assuming that the steel tape is used, the comparison between the length of the base line and its measurement by the ordinary traverse line methods will give the means of ascertaining the temperature at which the tape can be regarded as standard, in its future use on the traverse lines.

A thermometer should be always carried in the field and all important measurements reduced to the standard temperature. Heliotropes have been used for city surveys. I have never used them for this purpose myself, but as I have found the heliotrope light shining through a half-inch hole quite bright enough at a distance of eighteen miles, I think it would be found necessary to subdue the light with screens of gauze, as has been suggested. I have found the heliotrope useful in all sorts of reconnoissance; however, on account of the exceeding brightness of its light, would recommend the engineer to procure or make himself a heliotrope. I have made one at a merely nominal cost that showed admirably at a distance of over thirty miles. In city work, if the heliotrope is used in reconnoissance, its light will of course be easily visible to the naked eye. The light will often penetrate underbrush and woods in a surprising manner.

After the angles of the triangulation are measured, the small errors of measurement should be distributed, so that all the conditions imposed by the geometrical figure may be fulfilled. If the engineer has the time and a little previous experience in such work, he may attempt to get the best possible distribution of these errors, by the method of least squares. The conditions should be

fulfilled in any case, and in general some approximate method of adjustment will be preferred to the theoretically best one. The triangulation points should all be referred to a system of plane rectangular co-ordinates. It is surprising to see that in some cities geographical co-ordinates are used in preference to those here recommended. To be sure, the charts on the U. S. Coast Survey are all provided with a degree projection, and the co-ordinates of the triangulation points are geographical ones, but the city engineer has no use for these, and if he thinks it a matter of sufficient interest he can easily add the degree projection to his maps after they are finished. What the engineer needs to know are the distances and directions of his triangulation and traverse stations from each other, and without the rectangular system of co-ordinates he can not find these with any degree of ease, and his whole survey has its value lessened very materially. If for any purpose the survey is to cover a very large area, so as to include the surroundings of the city, it would be well to use the system of spherical rectangular co-ordinates. The necessary formulas for use with this system are developed and given in convenient shape for use, in the volume of Final Results of the New York State Survey. After the triangulation is completed, traverse lines will be run through the streets, all the angles should be carefully measured, and the various polygons should be always closed, so that a check on the angular computations may be had. In general the closure of any traverse should be so small that a correction of 15 or 20 seconds to each angle will be the maximum. The distances between traverse stations should always be measured twice, and these measurements, when corrected for temperature, should not show a difference greater than is indicated in the formula, $e = 0.05\sqrt{D}$, where e is the difference between the two measurements, and D is the distance expressed in units of 100 feet.

A difference of only about one-third of this amount would be generally expected. I have found that the angular points of the traverse, when marked by spikes driven into the joints of the pavement or sidewalk, can be easily recovered; and even if these spikes were removed, their positions should be capable of recovery from the detail measurements, in most cases. It is not worth while, in general, to mark the traverse points more permanently. Even in

the very careful and detailed survey of the city of Berlin such marking has not been undertaken, although in some of the smaller cities of Germany the main points of the traverse have been more permanently marked. From the traverse points the corners of the streets and alleys, with the bends in the street lines, are located by measurement of the angles and distances. The maps are plotted on a scale of one inch to forty feet, for the most part, while in the outskirts a scale of one inch to eighty feet is to be used for the present. The sheets used measure 37x59 inches, and have the space of 34x56 inches covered by the map work; 126 of these sheets, if all were on the scale of one inch to forty feet, would be required to cover the entire city. An index sheet on the scale of one inch to four hundred feet, on which all the maps are shown, and all the traverse lines likewise, makes it easy to find the particular sheet wanted. The maps are kept on edge in a large case that will hold them all. This arrangement makes it possible to take out the exact map wanted without disturbing the others. Each map is divided into a network of squares of 1,000 feet on a side, running in the direction of the cardinal points, and from these the traverse stations and triangulation points are plotted. The block measurements are first made by taking a tracing from the insurance map, which shows all the buildings in a rough fashion. This tracing is on a scale of one inch to fifty feet, although it is sometimes necessary to enlarge it to double this scale. With this tracing as a sketch all the property lines and the stone and brick buildings are measured in the field, the measurements being written on in lead pencil; afterwards in the office these tracings are copied on sheets of heavy paper 8x10 inches in size, and each of these is numbered with the number of the block, sometimes several sheets being required for one block. On the general map with the scale of one inch to four hundred feet, already referred to, the blocks are all shown with their appropriate numbers, so that the detail sheets for any particular block may be easily found. As fast as possible the measurements of blocks are plotted on the large maps. Frequently an extended search of deeds becomes necessary, and occasionally additional measurements in the field are essential.

In reference to the important subject of levels, it may be said that it would be well if all the bench marks could be chosen,

marked, and described in advance of the instrumental work. For city work, bolts with spherical heads set horizontally into holes drilled into the walls of buildings and fixed into place with Portland cement mortar would be the best to adopt. The levelling should proceed according to some well devised plan, so as to divide the city into closed circuits; for the purpose of ascertaining the precision of the work from the errors of closure found, and of distributing this error so as to arrive at the best results. The engineer should familiarize himself with the procedure adopted in the carrying on of work of precision, when running lines of levels. The government reports relating to such work may be referred to with advantage.

The general attitude of the most influential and enlightened portion of the community toward the so-called representatives in the board of aldermen seems, in many American cities, to be one of profound distrust. The tendency is toward fixing the main responsibility on the mayor, as the real head of the city government. If this policy is to prevail, it would be well to have the mayor appoint the city engineer, absolutely, without confirmation by the common council. The regulations that are supposed to govern civil service appointments should be faithfully lived up to by the mayor, as well as by all other city officials. The mayor might appoint the heads of departments, but it would be advisable to require all municipal boards of civil service examiners to secure expert assistants in conducting examinations for technical positions, or else that a state board of expert examiners should be available in all the cities in the state. Our technical schools should see their interest in securing for their graduates examinations that will be real tests of merit and ability. Recently a good deal has been said and written concerning the organization of the city engineer's office. I wish to say in relation to this that I consider the employment of good men of far greater importance than the exact form of organization. Engineers, technical schools and all good citizens should co-operate to secure such persons. There are none so well fitted for positions in a city engineer's office as those who, having had a technical education at a school of engineering, and several years' practice of their profession, are content to settle down and devote their lives to the duties of a municipal engineer. These duties

will often be monotonous, they will frequently be unappreciated, but if the engineer conscientiously performs them, he will probably, in the end, secure the good opinion of the best and most intelligent members of the community. As municipal governments are conducted, very often the engineer will have to dispense entirely with popular approval and take as his reward a somewhat meager salary and the satisfaction resulting from useful work faithfully and honestly performed.

Horace Andrews,
City Engineer of Albany, N. Y.

HORACE ANDREWS, who has been the city engineer of Albany since 1886, was graduated from the Sheffield Scientific School of Yale University, with the degree of Civil Engineer, in 1872. He was engaged on hydrographic work, under the United States Coast and Geodetic Survey, in 1872, and for several years afterwards was connected with the same survey, first in connection with the survey of the harbor and vicinity of New Haven, Conn., and afterwards on the east coast of Florida. Mr. Andrews was called from Florida, in 1878, to accept a position as assistant on the New York State survey, a position which he filled till the conclusion of the survey, in 1884. He was then engaged in sanitary investigations under the board of health of the State of New York till his appointment as city engineer of Albany. He has been reappointed city engineer for four terms. During his incumbency over two million dollars have been expended on street pavements and sewers, and more than 250,000 square yards of cobble-stone pavement have been replaced with granite and asphalt.

PAVING BRICK IN ONTARIO.

THE third report of the Bureau of Mines of Ontario contains a very thorough review of the use of vitrified brick for street paving in the United States, supplemented with information as to its availability in Ontario. "So far as is known," the report says, "only two places in Ontario have made use of brick as a paving material. One of these is the town of Chatham where, in 1890, a brick pavement was laid down on King street, from the Rankin House almost to the Garner House, the busiest part of the main thoroughfare. The bricks were purchased from local brickmakers, and were made from clay adjacent to the town. They were not burnt hard enough for durability, but the pavement is in fairly good shape yet, and all are agreed that brick is the material for Chatham, pro-

vided suitable clay could be got, and the brickmakers there had the proper appliances for burning it. The other place where vitrified bricks have been put down is Toronto, and to those who have not watched local affairs closely, it may be news that there are four miles of streets in this city paved with vitrified brick, all of which were laid down last year. The following are the streets: Dundas street, from the bend to Lansdowne avenue; Lansdowne avenue, from Dundas to College; College, from Lansdowne avenue to Bathurst; Bathurst, from Queen to Bloor. The pavement is between the street-car rails only. The bricks of which it is composed are all imported from the United States, partly from Massillon, Ohio, and partly from Canton, Ohio. The foundation is a bed of concrete, on which is laid a cushion of sand one inch in thickness, and on this the bricks are placed on edge at right-angles to the curb. They are laid as close to one another as possible, and the interstices are completely filled with paving pitch, or Portland cement. Pitch is used on Bathurst street, between College and Queen, and on College street between Bathurst and Dufferin, and cement on the remainder of the pavement. The cost of paving brick laid down in Toronto is from $20 to $23 per thousand, made up as follows: Price at place of manufacture per thousand, $9 to $10.50, freight $9, and duty $3. It takes from 60 to 64 bricks to lay a square yard of pavement, allowing for breakages. The brick pavements in Toronto having been down scarcely a year do not afford data for a conclusion as to their durability; we expect them to be yet practically uninjured, and as good as when laid down. This on examination we find to be the case, and although, owing to the pavement being between the car rails only, and thus by its position as well as by its smoothness, offering a double inducement to vehicles of all kinds, it has received more than its fair share of travel, the only visible mark of wear is a slight rounding off of the edges of the bricks. The comparative cost of the various kinds of pavement used in Toronto is as follows, including foundations:

	Per Sq. Yard.
Cedar block on 6-in. sand	$ 75
Cedar block, on 2 layers of 1-in. boards, with tar composition	1 30
Cedar block, on 6-in. concrete	1 50
Light asphalt, 4-in. concrete, 2-in. asphalt	2 10
Vitrified brick, on 4-in. concrete	2 25
Heavy asphalt, 6-in. concrete, 2½ in. asphalt	2 60
Granite sets on 6-in. concrete	3 85
Scoria blocks on 6-in. concrete	4 00

"The city authorities are very favorable to the use of brick as a paving material, considering it suitable for traffic of any kind, whether heavy or light. If good paving bricks were made here and sold for the same price as that charged by the United States manufacturers in their own markets, a saving of from 65 to 75 cents per square yard over present cost could be effected, which would reduce the cost of brick pavement to practically that of cedar blocks. In such a state of affairs there would be no choice whatever between the two kinds of pavement. The odorous, bumpy, short-lived block would disappear forever before the clean, smooth, warm-colored and durable brick. There are miles of cedar block pavements in Toronto which are approaching the point when they must either be renewed or replaced by some better material. It would be a calamity if cedar blocks were again laid to furnish a repetition of the nuisance which this kind of pavement becomes in its unlovely old age; while on the other hand, a public benefit of no mean kind would be conferred by replacing them with smooth, lasting and sanitary brick roadways."

The report urges a good foundation as quite as essential with vitrified brick as with any other kind of paving material. "However excellent the surface covering of the street may be," the report says, "it can not but fail of achieving the best results if it does not rest on a proper substructure. The road-bed should be thoroughly drained, so as to secure the greatest possible freedom from moisture, that arch-enemy of pavements, equally objectionable in fluid or frozen form. When brought to proper sub-grade, the whole surface of the roadway should be thoroughly consolidated by rolling or ramming. If the bed to overlie this is of gravel or broken stone, it should consist of pieces of uniform size, not too large, and free from dirt. If of concrete, the sand entering into the latter should be sharp, the cement of first-class quality, and there should be a due proportion of each in the mixture, say three parts of sand to one of cement; and the fragments of stone to complete the concrete should be angular, with rough faces, clean and not excessive in size. It is evident that for heavy and constant traffic, a foundation such as is described above is an absolute necessity, if a brick pavement is to have a fair opportunity of proving its smoothness and durability. For lighter traffic a less expensive foundation may

suffice. The engineer of an Ohio town states that last year he put down a considerable area of brick pavement on a foundation of six inches of clean gravel, and one inch of sand. The usual drain pipes were omitted. The whole pavement, when completed, cost $1.28 per square yard. Such construction might perhaps serve the purpose in small towns, but could scarcely be expected to stand the strain of heavy traffic."

No general or systematic examination has yet been made of the clay or shale deposits of Ontario with a view to determining their value for manufacturing purposes. The Erie and Saugeen clays are largely used in the manufacture of building brick. The opinion is expressed in the report that in the Hudson river and Medina formations there are inexhaustible supplies of material suitable for paving brick and sewer pipe. Following is an analysis of the Hudson river shale:

	Per Cent.
Hygroscopic water	1.50
Water (combined) and CO_2	5.51
SiO_2	60.55
Al_2O_3	14.79
Fe O	7.58
Ca O	1.81
Mg O	1.55

The Rosedale Pressed Brick and Terra Cotta Company, whose works are situated at the base of the high bank overlooking the river, have apparently a large supply of promising clay, and are also proposing to enter into the manufacture of brick.

The Toronto Vitrified Paving Brick and Stone Company have a very conveniently situated property on the east bank of the Humber. The Hudson river shale outcrops in the bank of the river and rises there perhaps twenty feet above the water. As the property extends over a number of acres there is a plentiful supply of the raw material. The shale is here interbedded with bands of calciferous sandstone of varying thickness.

The red Medina shales, which seldom have a less thickness than 500 feet, are already utilized on a considerable scale by various firms in the manufacture of pressed brick, terra cotta and tile, at Milton, Beamsville, Terra Cotta and eslewhere. At Hamilton they furnish the Hamilton and Toronto Sewer Pipe Company with the raw material for excellent sewer pipes and building brick, and the

company are now proposing to add to their extensive business the manufacture of vitrified brick. Their works consist of two distinct plants, one of which is not at present in use, but is likely to be made the scene of the new industry. A mixture of 50 per cent. shale and 50 per cent. clay is used for the sewer pipe, and a like mixture will probably be employed for the paving brick. The clay is simply disintegrated shale and is found immediately at the base of the mountain, where the shale in places outcrops under the Medina sandstone, as well as overlying the greater part of the level ground between the mountain and the bay. A quantity of the raw material was sent to Canton, Ohio, and manufactured into paving bricks there. An analysis of the mixed clay and shale ground ready for use, made by Dr. Coleman, is as follows:

	Per cent.
Water (combined) and CO_2	4.17
$Si\ O_2$	61.79
$Al_2\ O_3$	14.53
$Fe_2\ O_3$	8.35
$Ca\ O$	0.85
$Mg\ O$	2.28

The clay, being wet, was dried at 100° C. before weighing; and as it was red in color the iron was determined as Fe_2O_3.

To his building-brick manufactory on the outskirts of Toronto Junction, Mr. C. R. S. Dinnick is adding a plant for making vitrified brick. The raw material which Mr. Dinnick proposes to use is a mixture of the red Medina shale and clay, and after considerable time and money spent in experimenting he believes he has discovered the proper proportions in which such a mixture will give the best results.

The report, in urging the establishment of paving brick plants in Ontario, says: "Vitrified brick is fast assuming the first position on the list of paving materials in the United States, and it is coming more and more into use as its merits become known. We in Ontario can not long remain behind our neighbors; and, indeed, the chief if not the only obstacle in the way of its adoption here is the excessive cost induced by the expense of bringing the material from the other side. If the attempts being made to produce a first-class article from our own clays prove successful, this difficulty will to a large extent disappear, for the cost of manufacturing here ought to be little if at all above the cost of manufacturing in the

United States, and vitrified brick of Ontario manufacture should sell as cheaply, or nearly so, as that of Ohio or Illinois does in those States. The market is that of the towns and cities of the Province, of neighboring Provinces and perhaps—if production can be sufficiently cheapened—of neighboring States also. There is no danger of an exhaustion of the market, for so long as man maintains his gregarious habits, so long will there be cities and towns with streets to be paved and repaved; and as taste improves and higher standards are set up, people will demand the best, particularly if the best can be supplied at a moderate cost. The first manufacturers will have the field to themselves, for there is a substantial impost on the imported article, and even without it, the freight on a thousand of Ohio paving brick is almost equal to the prime cost, and quite sufficient to give the home manufacturer an indisputable advantage in the markets of his own Province."

CURRENT INFORMATION.

OPPOSITION TO MUNICIPAL OWNERSHIP OF LIGHTING PLANTS.

Much interest is evinced by the citizens of Albany, N. Y., in the electric light question, and the question as to whether or not an enterprise so extensive and so involved can be economically and satisfactorily run by a municipality is being discussed. Experiences and data obtained from other cities strengthen the opposition to ownership. Massachusetts investigated the municipal light plants of different cities and reported against the plan. A report of the State Board of Electric Light Commissioners of Massachusetts shows that of the private companies of that state engaged in the business, "six of the companies appear not to have earned expenses, and twenty-six others have not earned sufficient to warrant the declaration of a dividend; figured from their tables, the average dividend of all the companies was less than two and one-half per cent., and for that they had paid in taxes about $125,000." Philadelphia reports against the plan. Chicago runs its own plant and pays $163 per lamp. Four different committees, in questioning the expense of plants in four other cities, received four different answers, as follows:

	Little Rock.	Chicago.	Ypsilanti.	Aurora.
Mobile	$51.10	$83.00	$35.79	$67.99
Scranton	47.50	56.60	28.61	56.00
Milwaukee	81.00	73.00	37.00	67.99
Steubenville	60.00	54.75	40.00	60.00

Philadelphia claimed to make annually over a million dollars' profit, Richmond $33,000 and Alexandria $8,000; but the result of the expert examination of these claims, made for Massachusetts, reported officially, the Philadelphia municipal plant charged for gas $1.50, and lost over $100,000; Alexandria charged $1.62, and lost over $6,000; Richmond charged $1.50, and lost over $42,000. Mr. Andrew Hamilton, of Albany, N. Y., who gave these figures, said of this:

"The cause of this was at once apparent. Proper charges had not been made for the capital with which these plants had been constructed, and which was borrowed and interest annually paid. The depreciation through wear and tear, through disuse of machinery and later inventions appeared, and the like was not taken account of. The cost of insurance, the supply of water, the loss of taxes which the city should have collected from a private plant, all were overlooked. I took up the list, and upon investigation I found that the omissions I have cited were all there and more, too. Expenses and salaries were charged to other departments, losses were charged to construction account, and the book-keeping was a marvel of finance.

"Against a 2,000-candle light, two-set carbon lamp burning 4,000 hours per year, when coal costs $3.15 per ton, without any explanation, we are asked to base our conclusion upon comparison with places burning 1,200 candle power, of coal at $1.25 per ton, of crude oil or natural gas, for from 1,500 hours up. To illustrate the extent of this folly, I set about to reduce

to a common basis these various differences. I found that the question of depreciation had been fully investigated, and the opinion of a large number of the best electrical engineers in the United States obtained, also the opinion of the highest authority in Europe, together with that of a number of electricians who are managing plants for municipalities, and the unanimous report of all was that ten per cent. depreciation was very low. The interest is readily chargeable at current rates upon the cost.

"To give this the best test, let us take the lowest place reported in the printed list. Portsmouth, Ohio, where we are told that they light a lamp for $38.50 per year. From a report by the city clerk it appears that they have 120 arc light, 1,200-candle power, run 2,190 hours, steam power, coal costs $1.50 per ton, plant cost $53,000. The running expenses increased from $3,600 to $5,000. The cost, therefore: Running expenses, $5,000; interest, $3,180; depreciation, $5,300; insurance and taxes, $500; total expenses, $14,478; $105.57 per lamp per year for a 1,200-candle power lamp, and the engineers' and firemen's wages charged to the water-works department; running 2,190 hours, and costs $4\frac{81}{100}$ cents per hour. Reduced to Albany standard of time and light, this would be: Cost per hour .0482; cost per 4,000 hours, $192.80, for 1,200-candle power; cost per 100-candle power, $16.066; cost per 2,000-candle power, $321.32.

"As coal here costs $3.15 per ton and there $1.50, the average consumption per lamp being nine tons per annum, the difference of $1.65 per ton, or $14.85 must be added to the cost of a 2,000-candle power light for 4,000 hours at Portsmouth prices, which makes the cost per lamp per annum $336.17. I present a report of similar official statistics from each of the places mentioned in the list I have referred to except three, and have carried the same principle of applying the cost per 100-candle power and per 100 hours, and the difference in coal, and the result is to be found in this table:

	Candle power,	No. hours lighted.	Coal per ton.	Lamps, No.	Expense, Total.	True cost per lamp.	P. & K. per p. L.	Comp. cost estd.
Easton	2,000	3,219	$2 85	108	$15,900	$147 22	$82 40	$185 54
Ashtabula	2,000	2,190	2 10	56	6,600	117 85	77 00	224 86
Little Rock	2,000	2,190	3 16	130	15,920	118 68	70 00	216 70
Elgin	2,000	2,190	2 60	77	9,800	128 44	62 00	239 48
West Troy	1,200	3,750	3 15	92	10,550	114 67	60 00	203 84
Frederic	2,000	2,190	3 24	65	6,200	95 88	60 40	173 35
Aurora	2,000	2,622	1 80	186	15,957	117 33	58 40	190 60
Madison	2,000	1,460	1 25	86	8,740	101 62	58 00	285 53
Alexandria	1,200	4,750	3 07	92	7,972	86 66	55 00	154 84
Lewiston	2,000	3,000	Water	100	8,750	87 50	55 00	.....
Bloomington	2,000	2,247	1 75	220	26,961	121 25	51 60	219 69
Decatur	2,000	1,460	1 55	65	7,140	109 84	50 00	315 36
Hannibal	2,000	2,190	2 15	53	6,274	118 37	54 00	225 14
Bay City	2,000	2,460	2 55	150	13,897	92 65	49 00	156 22
Jamestown	1,200	2,190	1 50	138	9,555	69 24	44 00	225 57
Dunkirk	2,000	3,000	1 80	71	5,934	83 38	41 43	127 82
Portsmouth	1,200	2,190	1 50	120	14,780	105 57	88 50	336 17

"Only one in this table, thus carried out to its legitimate results, is lower than the Albany price. That is Dunkirk. There coal cost $1.30 per ton, and in taking the running expenses furnished by the city clerk, the only charges are for labor, one trimmer $660 and $120 for fireman for extra time. The superintendent's salary, en-

gineer and fireman's wages, the secretary's and collector's salaries, the bills for printing and stationery, office rent and repairs to station building, are all charged to the water department. A loss of $1,200 for three armatures known to have been destroyed is omitted.

"Topeka's own plant cost per lamp for 100 hours $3.71, which for 4,000 hours would be $148.40. In this price no allowance is made for depreciation, taxes or water rates, and coal cost $2.69 per ton, and allowing for these on the usual basis would make it $240.40 per lamp. Chicago has a municipal plant, or four plants representing an investment of $688,312. There are 1,110 arc lamps in use, which were operated for a total of 4,382,102 lamp hours per year, at a cost of $107,277.93 for labor and material, or $96.65 per lamp per year. Add to this the city bonds issued on the plant, depreciation and insurance, amounting in all to $73,990, or $66.65 per lamp, which brings the total cost per lamp to $163.30, and even this figure does not include the loss to the city or water rates.

"Philadelphia, in 1894, made an extended examination of this question, with a view of establishing a 400-light plant, and if satisfactory to be followed by others. That city had for years owned its own gas plant, and in its suit against its trustees, proved that by bad management the city had lost three and one-half millions of dollars. They proceeded cautiously and thoroughly, and as a consequence the committee reported unanimously that it would be unwise and unprofitable, and contracts were made for the current year with private companies for 3,472 lamps at a price of $150 each per year. Their report was that a 400-light plant would cost $251,763, and the annual expense, $61,791.95. Philadelphia's estimate of a plant was at a cost equal to $629.40 per lamp. Chicago's plant actually cost $620.10 per lamp. At those figures, Albany's 600-light plant would cost, the highest, $377,640, the lowest $372,000. If it were intended and so constructed that more lights could be added, if needed, about $100,000 additional would be required. The interest at 3 per cent. with the depreciation on the lowest price would be over $60,000 annually; and to this add Chicago's experience of $96.65 per lamp annually for labor and material.

One other topic remains. A correspondent writes that 185 cities in Great Britain save money by their own lighting plants, and quotes from Mr. Chase's book on "Municipal Governments in Great Britain," where he says that the price in large towns is generally from 50 cents to 75 cents per 1,000 feet for gas. A single quotation from Mr. Francisco, a writer upon this topic, but who happily has examined the whole question, the whole range of results both private and municipal, shows us the value to be attached to the price as quoted from Mr. Chase.

"We are told continually that in England and Scotland municipal ownership is a great success.

"As an illustration, we will refer to some of the gas works. The records show that private corporations made for every ton of coal carbonized, 11,187 feet, while the municipalities made 9,951 feet, being an average of over 12 per cent. in favor of the private companies. Again, compare the gas lost between the meter and the works, and we find that the municipal

plant lost 8.46 per cent., while the private company only lost 7.87 per cent.

"The profit which a gas company can make depends somewhat upon its residuals. Reports show that the municipal corporations' average per cent. was 43.72 per cent., while the private companies average 68.72 per cent. The cost for labor to carbonize coal enough to produce 1,000 feet of gas for the municipal corporation was 7.28 cents, and for the private company was 5.69 cents.

"Again, coming to one important part of the entire business, viz., profit, we find that the average price paid by consumers to the municipal corporation was 61 cents, while they only paid the private company 57⅔ cents.

"The above facts show conclusively that municipal ownership of gas in England and Scotland is not such a brilliant success as its advocates in this country would have us believe. The same conditions can be found in this country. As a sample, compare the percent. of decrease in prices of gas.

"In Philadelphia, where the benefit of municipal ownership has been fully tried, the decrease has been only 35 per cent.; in Richmond 50 per cent., while in New York, where the gas is furnished by a private company, it has been 54½ per cent.; Baltimore, 63½ per cent; Cincinnati, 49 per cent.; Boston, 66 per cent.; showing the decrease in price in every case has been larger when private companies furnish the gas than it has been when furnished by the municipal authorities."

STEEL RAIL STREET PAVING.

Steel rail street paving has been proposed to the contractors at Chicago, by W. W. Carland, of that city. The system is in use in a small way in New York city. The approaches to the Pavonia ferry, and the wharf and pier being paved with the rails. The pavement consists of steel rails, T-shaped, which are laid two and a half inches apart, and spaced by dividing blocks of either wood or cast iron. The spaces between the rails are filled with concrete, asphaltum, or some similar material. The webs of the rail rest upon wooden stringers, which are laid upon a foundation of crushed stone. The webs taper so that the rails can be easily removed when repairs below the surface are necessary. The asphalt or concrete between the rails serves to give footing, and deadens the sound of travel. It is claimed for this paving that it will wear for forty years, and that it will cost about $2.21 per square yard.

AN ELECTRIC STREET RAILROAD CONDUIT.

A conduit, the construction of which is similar to that of a cable conduit, has been designed by A. H. Connett, for the Metropolitan Railroad of Washington, D. C. The insulators are of porcelain, but so constructed that if it does not serve well the purpose, it can be changed with very little trouble. The conductors are hung from the roof of the car. A regular man-hole is placed at each insulator, so that insulation can be reached without interfering with the pavement. The man-holes are 13½ feet apart. The contact will be a sliding one, along the vertical faces of the steel conductor, the contact device being under the truck, similar to the grip on a cable road. This method will effectively reduce the oscillation that would take place if it were attached to the car body. A complete metallic circuit will be

used, neither side being grounded. The feed wires are carried in terra cotta ducts and tapped in, at proper intervals, to the steel conductors. The Metropolitan company will put in eight miles of this road, in a few weeks, on the Ninth-street line, and if it is successful the F-street line will be equipped the following year.

A PLAN FOR PAVING A SMALL CITY.

A report by William Pierson Judson, C. E., on "Roads and Pavements Suited to Oswego, N. Y.," prepared for the consideration of the common council of that city, has been printed in book form, accompanied with illustrations. It is more than a consulting engineer's plan for work, as it is intended to influence the forming of public opinion, and is applicable not alone to Oswego, but to other towns of from twenty to thirty thousand population. In discussing the comparative qualities of pavements he gives asphalt first rank and credits vitrified brick with being "its only rival for public favor" in the qualities which distinguish it, namely, durability, cleanliness and noiselessness. He describes other paving methods and materials, however, giving such information regarding them as may lead to the formation of judgment as to their merits.

He recommends for the main business streets of Oswego sheet asphalt laid upon the present cobble-stone and block sandstone pavements, which are to be used as a foundation; for business streets having grades steeper than three per cent. he recommends block sandstone, laid on a six-inch concrete base, with joints of hot sand and paving tar; for semi-business streets and thoroughfares he recommends vitrified brick laid on a six-inch concrete base; for residence streets, sheet asphalt, or if a cheaper pavement is desired, vitrified brick with gravel or broken stone foundations; for temporary and immediate improvement of residence streets generally, he advises the sub-grading, narrowing and rolling of dirt roads and a top surface of clean gravel.

DEATH OF THE FATHER OF AMERICAN ASPHALTIC PAVING.

Prof. E. J. De Smedt, the inventor of American asphaltic paving, is dead.

PROF. E. J. DE SMEDT.

Prof. De Smedt was a Belgian chemist, and a graduate of the University of Brussels. He had studied asphalt pavements in Paris before coming to the United States in 1861. He conceived the idea, in 1869, of making a mixture of properly selected sand and pulverized carbonate of lime, cemented together by suitable asphalt, the latter being first refined and tempered with heavy petroleum oils or the residuum of distillation of them. In 1870 he laid the first sample of this composition for public use in front of the city hall in Newark, N. J. In 1873, Fifth avenue, opposite the Worth monument, between Twenty-fourth and Twenty-fifth streets, in the city of New York, was paved with this asphalt, and other samples of it were subjected to trial at about the same time. These pave-

ments had given such good results that the commission appointed by Congress in 1876 to pave Pennsylvania avenue in Washington, D. C., selected, from among a great number of proposals, De Smedt's composition, and this pavement was laid under his direct supervision.

When Major Swining, United States Engineer, was appointed as engineer commissioner of the District of Columbia, De Smedt was offered the position of chemist inspector of asphalt and cements for the city of Washington, D. C. His duty was also to instruct the contractors in the manipulation and laying of the asphaltic pavement as invented by him. He continued in that capacity for nine years, and resigned his position in 1887 on account of ill health.

For several years he has been the chemist and expert of the New York and Bermudez Asphalt Company, and was in their employ at the time of his death.

TESTS OF KENTUCKY PAVING BRICK.

The Pittsburg Testing Laboratory, Pittsburg, Pa., recently made tests of paving brick manufactured from the clays of Cloverport, Ky. The abrasion test, made by revolving the brick for one hour and ten minutes in a foundry scouring barrel, with castings weighing five or six pounds, showed the following result:

ABRASION TEST.

"A"			"B"			Loss in Wt.			Per Cent. Loss in Weight.
Lbs	Ozs	Grs	Lbs	Ozs	Grs	Lbs	Ozs	Grs	
3	8	454	3	7	120	0	1	334	.037

"A"—Weight of brick before putting in scouring barrel.

"B"—Weight of brick after being revolved in scouring barrel.

CRUSHING TEST.

Dimensions of Brick.	Wt. Appl'd "A" Lbs.	Wt. Appl'd "B" Lbs.	Lbs. Per Sq. Inch.
4⅜x4⅜x2½ ins.	95,000	100,000	4.963+

"A"—Brick showed several small cracks.

"B"—Cracks become more pronounced, and load was removed.

COMPARATIVE COST OF GRANITE AND BRICK PAVING.

Mr. Horace Andrews, city engineer of Albany, N. Y., makes some comments on brick-paved streets, in his annual report. He thinks the material "has passed the experimental stage," and says: "It has proved to be quite suitable for residence streets where the grades are not too steep. The question is often asked, Will brick last as long as granite? If the matter is considered in its proper light, I think this question may be answered by saying that, except possibly in the most heavily traveled streets, the same expenditure will give as lasting a pavement with the best quality of hard-burned brick as with granite, and the pavement will be better and be kept in better repair. Let us suppose, for example, that brick pavement can be laid in the best possible manner for $2.20 per square yard, and that it will have to be entirely renewed in a certain street every eight years, and that granite costing $3.10 per square yard will last in the same street without renewal for twenty-four years. Calling the expense of renewing the brick $1.04, and that of the granite $2.23 per square yard, the entire expenditure in the case of the brick pavement, including compound interest at five per cent. on all sums expended, and a renewal at the end of a period of twenty-four years, besides the two renewals at eight and sixteen years, will be

$11.94, while in the case of the granite, computed on the same basis, the entire expenditure will be $12.23, a difference of twenty-nine cents per square yard in favor of the brick. The above estimates are as favorable to granite as possible, $3.10 per square yard being a very low price indeed for granite laid on a concrete base, while the renewals are computed in both cases under the supposition of the best work, with tarred joints in the case of granite. Probably long before the expiration of a period of twenty-four years good paving bricks will be produced near at hand and, with the expense of transportation saved, the renewals can be effected at considerably less than $1.04 per square yard. I believe, therefore, that in all streets of moderate traffic, brick can be laid and maintained at a less cost than granite and that it will give much better satisfaction."

HOW STREET PAVING IS PAID FOR IN DIFFERENT CITIES.

The highway committee at Providence, R. I., was organized last year to inquire into the methods of paying for street paving in different cities. The information obtained is as follows:

New York—The whole cost of street paving is assessed on abutting property, to be paid in installments from five to ten years.

Albany—The entire cost of paving is paid by abutting property owners, after which the city assumes all expense of maintenance.

Syracuse—The abutting owners pay the total cost.

Troy—In streets over forty feet wide half the expense is paid by the city and the other half by the property benefited. In other streets the whole cost is paid by abutting property.

Philadelphia—Abutting property owners pay the whole cost, except for intersections, which is paid by the city.

Chicago—Abutting property pays for all street paving, payments being made in five yearly installments.

Baltimore—The whole cost is paid by property owners, except for intersections.

Minneapolis—Abutting property owners pay the total cost of paving in front of their property, but the city pays the cost of paving intersections and of pavement abutting property exempt from special assessment.

Jersey City—Whole cost paid by abutting property, except in cases of extraordinary heavy work.

St. Louis—Substantially all the cost is levied on abutting property.

St. Paul—Nothing is paid by the city.

Newark—Except for intersections the abutting property owners usually pay the whole cost of paving.

Indianapolis—The whole cost, including the paving of intersections, is borne by abutting property.

Cleveland—The city pays for street intersections and one-fiftieth of the entire cost, the balance being assessed on abutting property owners.

Cincinnati—The city pays two per cent. and for intersections.

Allegheny—Property owners pay the entire cost of paving in front of their property.

Pittsburg—Whole cost paid by property owners.

Detroit—Abutting property pays for all new paving, except for intersections. Assessments are payable within four years.

Milwaukee—The city pays for intersections, and abutting property pays the rest.

Omaha—Abutting property own-

ers pay for paving, excepting so much as may be assessed on street railroads, but the city pays for intersections, and for park and other non-assessable frontage.

Denver—The entire cost of grading, paving and curbing streets, including street intersections, is paid by abutting property owners.

Nashville—The whole cost is paid by the city.

Hartford—Outside of what is paid by street railroads, abutting property pays two-thirds and the city the rest.

Brooklyn—Abutting propertypays to the amount of the benefits it receives.

Rochester, N. Y.—Abutting property pays.

Toronto—Abutting property-owners pay for paving, except street intersections and sixty feet on street corners, the cost of which is paid by the city.

Buffalo—Entire cost is paid by the abutting property, but repairs are paid for by the city.

ASPHALT AS A STIMULUS TO IMPROVEMENT.

City Engineer Andrews says that asphalt pavements seem to have stimulated improvements in the city of Albany, and have certainly encouraged the use of bicycles, while traffic has very largely increased on streets where such pavements have been laid.

PUBLIC IMPROVEMENTS IN PHILADELPHIA.

In a paper read before the Engineers' Club, of Philadelphia, Mr. George A. Bullock, in charge of the Bureau of Highway Improvements, of Philadelphia, stated that there are now 869 miles of paved streets in that city. In consideration of franchises the street railway companies have been required to pave between their tracks 382 miles of streets. He estimates that it will cost from $15,000,000 to $17,000,000 to pave streets in which there are still rubble and cobble-stones. He thinks that appropriations for this purpose will be made gradually.

MUNICIPAL REPORTS.

Lynn, Mass.—The annual report for 1894 has been compiled by Wallace Bates, superintendent of streets, at Lynn, Mass. The amount of appropriation for the year was $55,000, of which $30,000 was for street improvement and $25,000 for sidewalks and street crossings. No appropriation was made for paving, so this work was chiefly confined to gutter paving and repairs, and was charged to highway appropriation. For street cleaning and cleaning crossings, $3,470.50 was expended. For labor in the removal of snow and ice, and in sanding icy sidewalks, $4,692.69 was expended. Superintendent Bates recommends that measures be taken at once to have the ordinance in relation to the clearing of sidewalks of snow and ice rigidly enforced.

Binghamton, N. Y.—The city has expended for pavements, up to date, $411,645.78. Of 110,927.20 yards of wooden pavement laid, but 57,686.39 yards are now in use. The cost of the city's asphalt pavements, which includes 83,544.43 square yards, has been $233,183.71. Of brick pavements the city has 3,481.26 square yards, at a cost of $8,335.02. Of a total of 197,953.59 square yards of pavement, but 44,712.08 square yards are now in use. The city has 7 miles of brick sewer, 18¾ miles of vitrified pipe sewers, and 1,590 feet of iron pipe

sewers, together with 709 catch-basins, 403 man-holes, and 59 flushing tanks. The total cost of sewer construction is $402,058.11.

Cambridge, Mass.—The report of the park department of Cambridge, Mass., for the last fiscal year comprises a volume of 120 pages, bound in cloth, and beautifully illustrated. The report fully explains the plans of the park commission in extending the park system in accordance with the advice of landscape architects, and the details of work are carefully set forth, illustrated with maps. The proposed dam for Charles river will cost, it is estimated, $1,565,000, which is much less than the cost of the proposed tidal basin. The report of the superintendent of parks gives much interesting information as to the care and cultivation of trees, while the report of the landscape architects, Messrs. Olmstead, Olmstead & Elliott, outlines various plans for the improvement of the park system. The work has been largely of a preliminary character. The volume includes a report from City Engineer Hastings of the work done during the last year under his direction.

A CITY ENGINEER'S CHARGES.

A few weeks ago Harvey Linton, city engineer, of Altoona, Pa., charged W. L. Shellenberger, president of the common council, with compelling contractors, by intimidation, to purchase material from him for use in public work. A special committee was appointed by the council to investigate the charges. The committee has submitted a report exonerating Mr. Shellenberger and at the same time advising that it would be well for councilmen and other city officials to refrain from furnishing supplies to contractors engaged on municipal work. The committee justified Mr. Linton's action by saying that the information furnished him warranted the filing of the charges, but that he had been misled by it.

TEST OF THE NEW WATER-WORKS AT OTTAWA, ILL.

An official test was made of the new water-works system of Ottawa, Ill., February 28, and the event celebrated by the citizens and officials from neighboring cities. Mr. Andrew Rosewater, of Omaha, Neb., who designed Ottawa's sewer system, the establishment of a system of grades, and the preliminary work on the water-works system, was present. The test was perfectly satisfactory in every respect, and complied with the ordinance under which the works were constructed, and which called for ten streams 110 feet in the air and 130 feet horizontally. The streams were thrown from 100 to 165 feet for two hours. A number of clay manufacturing industries are located in the city, the product of which is used in all of Ottawa's public improvements. The brick pavements, sewers, tile walks, churches, stores and hospital are all constructed of the clay manufactured in the city. The Ottawa *Journal* issued a special water-works edition of twenty pages, March 3, which contained many interesting descriptions of the city's progress in municipal work and its enterprises, together with many illustrations of the public buildings, officers and the sites around the city.

THE NORTHWESTERN PAVING EXPOSITION.

The Paving Exposition, to be held in Minneapolis and St. Paul, under the auspices of the Twin City

Commercial Clubs, will open in Minneapolis, on Monday, April 1st, and will continue for one week, when the exhibits will be removed to St. Paul. About forty paving companies will be represented by exhibits of materials. The exposition will be held in St. Paul, in the Washburn building, from April 8th to 13th, inclusive. The Exposition is for the purpose of better enlightening the citizens of the two cities on the merits of paving materials and methods, preliminary to inaugurating extensive street pavement work. Open meetings will be held during the progress of the Exposition, at which papers on the subject of paving will be read and discussed. The Exposition is modeled after the one held in Indianapolis, under the auspices of the Commercial Club, in 1890.

WAGON-WHEEL TIRES.

The agricultural department has issued a bulletin compiled by Roy Stone, special agent in charge of road inquiry, containing information concerning the use of wide tires on wagon-wheels. Mr. Stone regards it of special importance in the maintenance of public highways that the vehicles used on them shall have tires of greater width than are now in general use. Extracts from the State laws respecting the width and tire to be used on vehicles are given, some of which offer a rebate of a portion of the highway tax on wagons, with rims or tires not less than three and three and a half inches in width. Ohio makes it unlawful to transport over macadamized, gravel or stone roads in any vehicle having a tire of less than three inches in width, a burden of more than 2,000 pounds. Indiana has a law against hauling on a wet gravel road a load of over 2,000 pounds on the narow-tired wagon, or over 2,500 pounds on a broad-tired wagon. Kentucky makes a distinction in favor of broad-tired wagons in fixing toll rates. The results of experiments with wide tires in various States are also given.

The bulletin concludes by printing extracts from the consular reports concerning the width of tires prescribed in various foreign countries. In France, every freighting and market cart is said to be a road maker. Their tires are from three to ten inches in width; usually from four to six. The German law prescribes that wagons for heavy loads, such as coal, brick, earth, and stone must have a width of tire at least four inches. Switzerland requires wagons to be provided with wheels having tires of a width proportional to the largest loads admissible.

ROAD LEGISLATION IN MONTANA.

The regular monthly meeting of the Montana Society of Civil Engineers was held in Denver, March 9. Mr. F. H. Ray, reported that legislation had been secured, which, while leaving much to be desired, was a step in the direction of good roads without additional expense.

STREET PAVING IN ST. PAUL.

Considerable paving will be done in St. Paul during the summer. Regarding the work to be done, and the various kinds of pavements to be constructed, City Engineer Rundlett says: "The necessity of doing a large amount of repaving during the season of 1895 has come to be a recognized fact. The old cedar block pavements, laid on plank foundation, which have been down from ten to thirteen years, are really beyond any economical

repairs, and the business interests of the street demand their immediate renewal. There is also a general sentiment among the property owners that whatever is done should be done in a thorough and substantial manner, taking advantage of our own experience and the experience of other cities.

"The first essential for a pavement is a good foundation. The wearing surface, or pavement proper, does not in itself support the load brought upon it, but resists the impact and abrasion incident to the traffic, and transmits the weight directly to the foundation upon which it has been placed. Experience has demonstrated that concrete placed on a road-bed, properly drained and consolidated by rolling, forms the best foundation for a street of heavy traffic (the depth of the concrete varying with the requirements of the traffic).

"Experience further indicates that granite blocks, asphalt and brick are the three kinds of paving material that have best answered the requirements of street pavements. But very little granite pavement has been laid in St. Paul, owing to the prejudice on the part of the business men against this class of pavement, on account of noise occasioned by traffic. The granite quarries at St. Cloud and vicinity form an inexhaustible supply of this material, and granite blocks can be laid in St. Paul as cheap as in any other Western city. Lower Third street is now under contract to be paved with granite blocks on concrete foundation, and it is intended to make this a sample of the best class of construction.

"Asphalt has been laid in St. Paul or eight years, with good results, and has given the best satisfaction of any pavement laid. The high first cost of the pavement has been a drawback to its general use. With the discovery of new deposits, and experience in manipulation, there is a favorable prospect of very considerable reductions in the cost. Seventh street, from Kitson to Seven Corners, is now under contract to be paved with asphalt; Sixth street, from Sibley street to Smith avenue, is ordered paved, and a preliminary order has been given for Fourth street, from Broadway to Seven Corners.

"While but very little brick pavement has been laid in St. Paul, the cities to the east and south have experimented very extensively with this material with more or less favorable results, depending largely upon the quality of the material selected and the manner in which it has been laid. Great improvements have been made in the way of manufacturing and burning bricks for paving purposes within the past few years, but, at the same, many bricks have been put on the market for paving which have not been found satisfactory. The best paving bricks or blocks are made from shale found in the vicinity of coal deposits and from the fireclays of Ohio and West Virgina. No good paving bricks have as yet been manufactured in Minnesota, although it has been claimed that suitable clay has been found within twenty miles of St. Paul. The bringing of the brick from the East adds largely to the cost, freight rates being nearly equal to the first cost of the brick. The "Metropolitan block," laid on Summit avenue, is a sample of the very best class of shale repressed brick manufactured. It is evident from the very contradictory reports received from the various cities where bricks have been used to any extent that

to get a satisfactory pavement the greatest care must be taken in the selection of the material and the methods of laying.

"Good streets do more to increase the values of property than any class of public improvements, and no feature of a city more favorably impresses a stranger than well-paved and well-kept streets."

PERSONAL.

Mr. Lewis William Hoffmann, of the firm of Hoffmann & Hochstetter, chemists, at Cincinnati, died in that city early in March.

Mr. August G. Parkhurst, president of the Parkhurst Paving Co., Minneapolis, died March 15, aged 75. He was the patentee of the Parkhurst combined curb and gutter.

LETTERS FOR THE PUBLIC.

CREOSOTED WOOD PAVEMENT IN GALVESTON, TEXAS.

To the Editor of Paving and Municipal Engineering:

I have recently become a subscriber to your magazine and have become much interested in many of the articles therein contained, and thinking that our experience may interest some of your readers, ask its publication.

In 1875 this city had laid seven blocks, or about twelve thousand yards of creosoted pine blocks, all of which are perfectly intact and free from decay at this date, and owing to this satisfactory test, contracted last year for thirty-seven blocks, or about sixty thousand yards, of this character of pavement. Still another contract has been made for thirty-seven blocks this year, which we have about completed. The board of public works are now advertising for ten thousand yards more, and as this character of paving material is rather out of line with that used in other parts of this country, I will explain the manner of procedure.

Our blocks are cut from yellow pine, five inches thick, five and six inches deep, and from six to ten inches long. We erected a creosote works, with a capacity of thirty to thirty-five thousand feet, for the preservation or creosoting of the blocks. The blocks are loaded in iron cages, each containing about five thousand feet, board measure. Six of these cars are used for each charge.

We have twelve cars or two shifts. The cylinder is nine feet in diameter, and one hundred feet long, with track laid on which the cars are run in. On the bottom of this cylinder, between the tracks, are six thousand feet of one-inch pipe, through which super-heated steam, at a temperature of from five to six hundred degrees, is circulated. After the cars enter the cylinder, the adjustible ends or heads are closed and bolted, making the cylinder air and steam tight. A jet of steam is then opened through a perforated pipe the whole length of the cylinder, when the wood is heated to the temperature of boiling water, the steam is shut off, and a vacuum pump put on, super-heated steam run through coils, and from fifteen to twenty inches of vacuum held until all moisture and air is taken out of the wood and cylinder. The oil or creosote is then let in from an elevated tank sufficient to fill the cylinder, from which a gauge is run by float in tank and target inside the works, showing the amount of oil discharged in the cylinder, which, by

displacement, shows the amount of wood to be treated, we having the total contents of the cylinder in advance, of course. We then put on a pressure pump and force into the wood the required amount of oil, which, for paving blocks, is twelve pounds to the cubic foot. The oil is then drawn off, the heads opened, cars drawn out and blocks discharged, ready for the street.

The method of paving here would not, of course, be applicable to other localities. The formation of this island is a pack sand. By flooding with water it can be packed so closely that a loaded vehicle will scarcely leave a track. After thoroughly saturating the ground we surface the street with forms the contour of the street, and on this grade we lay the blocks closely, as is done with brick or asphalt blocks. The interstices are filled with coarse clean and dry sand. The surface is rammed until the interstices are filled solidly with sand, and the surface smooth and even to conform to the contour of the street. The surface is then flooded with coal tar, liquified by heat to a sufficient degree to penetrate the sand joints, which is then followed by a second coating of paving cement, or thick mixture of asphaltum and dead oil. The surface is then covered with sharp sand, and the pavement is complete.

We flatter ourselves that we have a pavement equal to the best in this country, and filling more of the requirements of a first-class pavement than any other one material, namely: Durability, non-absorptiveness, low tractive resistance, freeness from noise, and for sanitation equal to asphalt, owing to the antiseptic properties of creosote or dead oil. Many of the European cities are using creosoted wood extensively, but we think we are the pioneers in this country. The writer laid several hundred yards of this material for the New Orleans Gas Company in March, 1871, which is perfectly intact today, and which has been subjected to heavy traffic for years.

J. W. Byrnes.

Galveston, Texas, March 7, 1895.

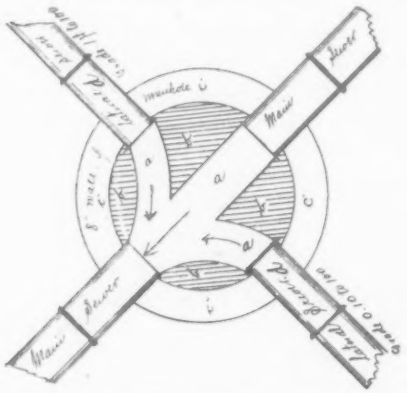
THE SEWER FARM AT ST. JOHNS, MICH.

To the Editor of Paving and Municipal Engineering:

The construction of the sewer farm at St. Johns, Mich., is completed, and also the construction of the outlet from the sewer farm to the city, together with the two mains to receive the laterals. The total length of sewers constructed, besides the sewer farm, is about five miles. This is the first sewer farm system in the state of Michigan. I have also made plans for a sewer farm system for the Feeble-Minded Home at Lapeer, Mich. The accompanying sketch shows the construction of man-hole bottoms according to my specifications. The man-hole is on a street corner, where sewers from all four directions are connected with it. Instead of having the man-hole bottom on the same level with the bottom of the sewers for the entire inside diameter of the man-hole, I only leave a channel of the same width as the sewer pipe (marked *a* in sketch). Also the lateral sewers I connect with the outlet sewer with a channel of the same width as the sewer pipe of said lateral, but this channel is put in on down stream curve. The balance of the man-hole bottom I build up to a height of two or three courses of brick, according to the flow of the main sewer, marked *b* in sketch. The advantage is easily to be seen. In the

first place, the sewage will not spread over the bottom of the man-hole; consequently it will not lose any force and will leave no settling. The sewer will clean itself. This is especially of great advantage in sewer systems where automatic flush tanks are used. It is my opinion that the man-hole bottom should be built ONLY in this way. As to leaving a hole in the bottom of man-holes below the grade of the sewer, I think it is altogether wrong and should not be allowed under any circumstances. The fact is that all sewage should be taken to the final place of disposal as rapidly as possible and not any of it be allowed to stay in the sewers or man-holes. If this were allowed to be, the sewers, etc., would be nothing else but a cesspool under ground.

The second advantage of my man-hole bottom is this: The lateral sewers can connect into the man-hole with a straight pipe (marked *d* in sketch) and not with a curve. This will enable the examining of said sewer in proper shape, giving the man a straight line to the next lamp-hole, which, if the connection was made with a curved pipe, would be impossible.



For this very reason no curved pipes should be allowed; the curve should be made, as shown in my sketch, inside the man-hole, which would give an advantage to the self-cleaning of the sewer if, everything else being equal, the grade of one lateral should be heavier than the other, say one be on a grade of one foot to 100 feet and the other 0.10 foot to 100 feet. This being the case, the sewage of the first lateral would certainly enter the sewer opposite with only a grade of 0.10 to 100 feet, and so interfere with or stop the flow of the sewage in the lateral. By putting the down-stream curve inside the man-hole the interference is stopped.

There are some more minor benefits derived from this man-hole-bottom; for instance, the man sent down to examine the sewers does not have to kneel down in the water; but I think those so far mentioned will prove that my idea is correct. I would like to hear, through your magazine, from other engineers whether any one has built the man-holes in the same way, and what experience they had, and what those who have not tried it think about it.

Jens Hartwig, C. E.

St. John's, Mich.

COST OF MAINTENANCE OF TELFORD PAVEMENTS.

To the Editor of Paving and Municipal Engineering:

In your February number I observe a statement as to cost of maintaining the Telford pavement in Berlin, the annual average being given at from 11 to 36½ cts. per square yard. These figures are far beyond any given in any book, or supplied by any experience that I know of. The highest figure (36½ cts.) is equivalent to one-third of the entire cost per square yard of a new pavement in their city ($1.20), and indicates that the surface of the pavement is

annually worn down from three to four inches.

In contrast with these figures, I send you clipping from one of the newspapers of this city, in which the annual cost of maintaining the Telford pavement here is carefully estimated. It should be said that our soil is a firm gravel, and our stone is basaltic trap, both furnishing the best conditions for a good roadway. On the other hand, the roadbeds are carelessly constructed, the wearing surface being mixed with loam, and very little care is taken to keep them in constant repair. By more attention to these last two requisites, the cost of maintenance would be considerably reduced. *H. T. Blake.*

New Haven, Conn.

[The newspaper clipping, referred to by Mr. Blake, shows the annual average cost of the maintenance and repair of Telford pavements in New Haven to be about as follows: In streets of heavy traffic, from 6½ cents per square yard down to five. In streets of medium traffic, from five cents per square yard down to three. In streets of light traffic, from three cents per square yard down to a fraction of a cent.]

COST OF CONSTRUCTING A BRICK SEWER BY DAY'S LABOR.

To the Editor of Paving and Municipal Engineering:

I send you herewith a statement showing the cost of constructing a 94-inch brick sewer by days' labor, compared with the cost of the adjoining section constructed under contract.

I believe this is the most extensive work constructed in the United States by days' labor, and it has been a success in every respect, as we have testimonials from several engineers unconnected with the department, certifying that the quality and character of the work is

COST OF 3-RING 94-INCH SEWER, 2,393.7 LINEAL FEET, BY DAYS' LABOR, IN DENVER.

ITEM.	Number.	Rate.	Amount.	Per Cent. of Whole.	Local Cont'r Rates.	Per Cent. of Per Cent.	Add Per Ct.	Subtract Per Ct.
Tools, etc			$1,024 82	2.081	Same			
Engineer, supervisor and watchman			2,013 10	4.087				
Foreman, days	119 1-8	$8.33⅓	997 10	0.806	$4.10*			
Labor, days	1,891	1.75	3,309 30	6.719	1.75*	80		1.344
Labor, days	545 5-8	2.00	1,091 25	2.216	1.75*	70		.665
Man and team, days	627 9-16	3.50	2,196 55	4.460	4.00*	91.4		.383
Pumping			802 16	1.629		150	0.814	
Draining			975 48	1.981	Same			
Foreman, days	118 1-2	4.47½	530 05	1.076	5.50†	1.22	0.239	
Stone masons	1,024 7-16	3.60	3,688 15	7.489	4.50†	1.25	1.872	
Brick masons	286 5-8	4.00	1,146 50	2.326	7.00†	175	1.745	
Helpers	1,627	2.00	3,254 00	6.607	2.00‡	93.7		0.416
Labor	600 ½	1.75	1,050 85	2.134	Same			
Portland cement, in ⅔ in vert, bbls	250	3.47	867 50	1.761	4.00‖	114	0.247	
Portl'd cement (rest) bbls	1,266	3.46	4,380 15	8.894	1.55**	44.8		4.907
American cement, bbls	4,849	1.35½	5,890 94	11.962	1.55**	114	1.675	
Broken stone, c. y	735 1	1.50	1,102 65	2.239	Same			
Rubble stone, tons	5,579 35	1.20	6,695 22	13.591	Same			
Brick, M	789	9.29	7,330 32	14.883	2.85§	93.1		1.022
Sand, c. y	2,317	.39 4	912 50	1.853	Same			
Centers, M. H., etc			592 97	1.203	Same			
Total			$49,251 51	100.000			6.592	8.778

A COMPARATIVE TABLE.

All labor to be compared with local contractor's 10 hours' labor.
*Ten hours. †Eight hours.
‡One-half days. ‖Per barrel.
**Louisville, per barrel. §Per foot.
Different in per cent., 2.145.
The board estimates a total saving of between $50,000 and $60,000.

vastly superior to that portion that has been done under contract.

We are now working on two sections, 70 and 77-inch respectively. As the solution of this problem on such a large scale is bound to attract a good deal of attention, we submit the data for your consideration and publication.

Arthur C. Harris,
Pres. Board of Public Works.
Denver, Colo., March 6, 1895.

AN OFFER TO MAYORS.

To the Editor of Paving and Municipal Engineering:

From now until June 1st I will send on application a copy of my pamphlet on "Brick Pavement" free to the mayor of any city contemplating paving this year. I am much pleased with your efforts to establish a standard for paving brick, with uniform tests. I have kept a careful record of brick paving for seven years and it shows that a standard is badly needed.

Chas. P. Chase, C. E.
Clinton, Iowa.

MACHINERY AND TRADE.

RECENT INVENTIONS.

[Reported specially for PAVING AND MUNICIPAL ENGINEERING by Chandlee & Chandlee, Washington, D. C.]

534,339. *Machine for Making and Repairing Roads.* Ortus E. Moats, DesMoines, Ia., assignor to Frederick C. Austin, Chicago, Ill. Filed March 9, 1891. Serial No. 384,297. A machine for making and repairing roads, of a body-frame pivotally connected with the front axle, a diagonally adjustable scraper-blade arranged to extend across the space between the front and rear wheels, a horizontally-swinging rear axle, a transversely arranged slide supported upon the body-frame, and a joined connection between said slide and an arm or hounds upon said rear axle.

534,441. *Metallic Curbing.* Israel L. Landis, Chicago, Ill. Filed Oct. 12, 1894. Serial No. 525,706. Combination of the iron beams which support the side-walk, supports for said beams, a metallic curbing secured to the outer ends of said beams, and a sidewalk supported by said beams, its upper surface being approximately flush with the upper edge of the curb.

TRADE NOTES.

The Dayton Brick Co. has been incorporated at Dayton, O.

A new brick plant has been established at Cosmopolis, Wash.

The Ferguson Construction Co. has been incorporated at Chicago, Ill.

Operations will be resumed at the paving brick plant at Chilhowie, Va.

The purchase of a portable stone crusher is advocated at Pottsdam, N. Y.

A company has been formed at Midvale, Pa., to manufacture brick.

The purchase of a stone crusher and roller is contemplated at Bristol, N. H.

A new cement mill will be started at Sellersburg, Ind., by St. Louis capitalists.

The Monmouth Sewer-pipe and Tile Company, at Monmouth, Ill., has been incorporated by J. H. Pattee, Wm. B. Smith, and M. C. Soule.

The citizens of Kenyon, Minn., are agitating the establishment of a brick-yard.

A brick plant will be established this spring at Dolgeville, N. Y., by R. J. Guile.

The National Asphalt Company, of East St. Louis, Ill., has been incorporated.

A twelve-gross ton steam road roller will be purchased at Jeffersonville, Ind.

A patent for a brick machine has been granted Emil Fernholtz, at St. Louis, Mo.

The city of Canton, Ill., is considering the purchase of a new stone crusher.

The Louisville Cut Stone Co., Louisville, Ky., filed a deed of assignment, March 7.

The question of purchasing a stone crusher is again being agitated at Bennington, Vt.

The highway committee, Fitchburg, Mass., contemplates the purchase of a stone crusher.

A new company will be organized at Bucyrus, O., to manufacture the Durant hollow block.

Wm. A. Blount, Washington, N. C., contemplates the purchase of clay-conveying machinery.

The brickmaking plant of S. Rush Hufford, Wytheville, Va., will be removed to Tazewell, Va.

A new plan for constructing a truss bridge has been devised by Jesse Kime, at Kendallville, Ind.

Articles of incorporation have been filed by the Superior Cut Stone Co., at West Superior, Wis. A large plant will be constructed. The incorporators are J. E. Greeley, Geo. E. Dietrich, and H. H. Grace.

Articles of incorporation have been filed by the Runyon Suspension Bridge Co., at Independence, Mo.

A fire in the foundry of Totten & Hogg, at Pittsburg, destroyed and damaged property to the extent of $6,000.

The Bellefontaine Stone and Lime Co. has been incorporated at Bellefontaine, O., with a capital stock of $12,000.

The Standard Granite Co., of St. Cloud, Minn., has filed articles of incorporation. Charles McLeod is president.

A reversing device for road engines and locomotives has been invented by G. Abrams, of Hutchinson, Minn.

The Anderson & Barr Clay Company, at Streator, Ill., are enlarging their works. Four kilns are being built.

The mayor and superintendent of streets at Holyoke, Mass., contemplate the purchase of a steam road roller.

The board of trustees of Sacramento, Cal., has requested that a rock or stone crushing plant be established at Folsom.

An extensive plant will be erected at Marshalltown, Ia., for the manufacture of county bridge and structural iron-work.

Judge C. F. Cooter, Trenton, Mo., contemplates organizing a stock company for the purpose of making vitrified brick.

The Pacific Asphalt Company has been incorporated at Chicago, to mine, refine, and deal in asphalt. Incorporators: John H. Breckinridge, Charles F. McKinley, and T. Judson Green. Capital stock, $50,000.

A large brick manufacturing establishment will be constructed during the spring, by B. F. Gravely & Co., Martinsville, Va.

A plant for manufacturing brick will be established at Gainesville, Fla., by C. M. Thompson and C. M. Rogers, of Brewton, Ala.

The Montpelier Brick and Tile Co., Montpelier, Ia., has been incorporated by L. P. Best, T. W. McClelland and Edward Emerson.

A plant is being erected at Weber's, near Perth Amboy, N. J., by the Ryno Granite Manufacturing Co., for the manufacture of paving blocks.

The plant of the Northampton Cement Co., Northampton, Pa., has been seized to satisfy a claim of $66,000 held by the Portland Cement Co.

The partnership of Geo. Dowell and Henry Spears, Pana, Ill., has been dissolved. A stock of nearly 300,000 building and paving brick will be sold.

An extensive plant for the manufacture of county bridge material and structural steel work will be erected at Marshalltown, Ia., by A. E. Shorthill.

The citizens of Fort Wayne, Ind., are endeavoring to secure the location of the manufacturing establishment of the Neff improved water system.

Britton Bros., Crawfordsville, Ind., are making preparations for making brick on a large scale this summer. A brick machine has been purchased.

The Ardmore Assay and Analytical Co. has opened a laboratory in Ardmore, I. T. The work of opening up the asphalt industry is progressing rapidly.

Mr. John Porter, of the John Porter Brick Co., contemplates the purchase of the Hoosier Brick Manufacturing Company's plant, at New Albany, Ind.

A large brick plant will be erected at S. Washington and Oak streets, Peoria, Ill., by the Garside Manufacturing Co. It will be fitted up with new machinery.

The board of highway commissioners, Pleasantville, N. J., has appropriated $2,000 for the purchase of a stone crusher. The matter will be voted upon.

Messrs. D. H. Kean, Canton, S. D., and O. C. Buck, of Perry, Okla., contemplate quarrying the stone, which is found in inexhaustible quantities near Perry.

W. H. Maltox, Heardmont, Ga., will open a large brick-yard this spring, and brick will be made by convict labor. One or two brick machines will be purchased.

A rich clay bed has been discovered in Buchanan, Mich., and a plant will be erected this spring for making pressed brick. The clay burns to a light buff color.

The western sewer pipe manufacturers held a meeting at St. Louis early in March for the purpose of discussing railroad rates and other matters of interest to the trade.

The Reinagel-Niemeyer Bricklaying and Contracting Co., has been incorporated at St. Louis, Mo., by Michael Reinagel, Joseph Niemeyer, A. Reinagel, and G. Niemeyer.

The towns of Bridgewater, Sangerfield and Trenton, N. Y., voted recently to purchase stone crushers. The towns of Marcy, Vernon and Verina, N. Y., voted against a similar question.

The Camden Press Brick Company has been organized at Camden, Ga., by F. M. Zemp, W. E. Glenn, and J. J. Goodale. A fine quality of hard-pressed brick will be manufactured.

The board of public works, La Crosse, Wis., has entered into a contract with the O. S. Kelly Co., Springfield, O., for a fifteen-ton steam road roller, with drag and plow attachments.

The Improved Asphalt Pipe Co. has been incorporated at Kern City, Cal., to manufacture and sell pipe for conveying water, gas, and other underground wires, and to construct reservoirs, etc.

The Rumford Falls Brick Co., has been organized at Dixfield, Me., by G. W. Ridlon, B. L. Rowe, J. L. Howard, and W. B. Irish. The company contemplates making 2,000,000 brick this summer.

The price of cement was increased from 12 to 15 cents a barrel at a recent meeting held in Chicago by representatives of the Milwaukee Cement Co. and the Louisville, Ky., and Utica, Ill., companies.

Pressed brick, street-paving brick, and all classes of building brick, will be manufactured by Andrew Harrison, at Mexico, Mo., who recently began operations. A test of the clay has proved it of the best quality.

An advance has been made in the price of Indiana limestone, especially in the prices for curbing and gutter. The price for five-inch curb, dressed to conform to city specifications, has been placed at 47 and 48 cents per lineal foot. This action was inaugurated by the Greensburg limestone quarries, and the plants in co-operation are at Osgood, Ashton, Wagner, Eureka and Harris City.

The Fruin-Bambrick Construction Co., of St. Louis, Mo., was awarded the contract for the construction of the new dam for the Holyoke Water Power Co., at Holyoke, Mass. Three years is allowed in which to complete the contract.

A company is being organized by J. G. Shea, Danville, Ill., to take charge of the Hutmacher plant, at Quincy, and begin, at once, the manufacture of paving brick. The company will consist of J. G. Shea, Danville, and E. K. Stone, Jr., Chauncey Castle and W. S. Warfield, of Quincy.

The Oppenheimer Brick and Tile Co., of San Antonio, Tex., has been chartered, with a capital stock of $50,000. Incorporators: Daniel, Anton, Jesse D. and Henry Oppenheimer, and Emil Calken, of San Antonio; Lewis Osterweis, of New Haven, Conn., and Oswald Kutsche, of Chicago.

The Purington Paving Brick Co., Galesburg, Ill., was awarded the contract for furnishing brick for the street paving that will be put down in Rock Island this year. The works of the Purington Company are in full operation, and the outlook for the brick business this season is encouraging.

The Eureka Pressed Brick Co., Gloversville, N. Y., has passed out of existence, and a new company formed, which will be called the Cayadutta Brick Company. The members of the new company are: C. S. Cummings, O. L. Everest, C. H. Abbe, N. M. Banker, and Edgar A. Spencer. The old plant will be retained, and important additions will be made. Tests made of the clay resulted in a hard, solid brick of a superior quality, especially adapted to paving purposes.

The Big Creek stone quarries were sold at receiver's sale, February 21, at Bloomington, Ind., and were purchased by Robert C. Greeves, who represented a number of creditors, for $6,900. The quarries cost, originally, $25,000. They will be operated in future by the Indiana Steam Stone Works Co.

The theory is maintained by engineers of Peoria, Ill., that the brickmakers of that city have the material to compete with the world in the manufacture of paving brick. A comparison of the clays and shales obtained in different localities has satisfied them that the main difference lies in the process of manufacture.

A new invention, known as papaduras, and prepared from pulps of various kinds, is said to make a good street pavement. The pulp is mixed with sand especially prepared, which gives it the necessary durability. The papaduras can be molded into any shape and is especially adapted to the making of furniture, car wheels, railroad ties, etc. H. H. Filley, city engineer at Kansas City, Mo., will experiment with the material street paving.

A permanent organization was perfected, March 5, at Bloomington, Ind., by the leading quarry owners of the Indiana Oolitic district. Officers were elected as follows: President, Col. A. C. Voris, Bedford; vice-president, B. F. Adams, Sr., Bloomington; treasurer, Ira C. Batman, Bloomington; executive committee, Messrs. Matthews, Buskirk, Wicks, Craig and Reed. The demand for oolitic stone this season promises to exceed the capacity of the quarries.

A consolidation of the stone quarries of Joliet, Ill., is probable. The quarry business is an extensive one in that vicinity, having been started before the city was incorporated, and increased until Will county now has twenty-six quarries. The estimated worth of the sixteen companies that will be consolidated in the proposed organization shows a total of $1,204,300. For the last two years business has suffered considerable depression, and this effort for united action will, it is claimed, be of great benefit to all concerned—the owners, the workmen, and the public.

Schoellkopf, Hartford & Maclagan are now sole agents in the United States and Canada for the Gas Light and Coke Co., London, England, the largest producers of gas tar and its products in the world, and for Hird, Hastie & Co., shippers of blast furnace tar and pitch. They are now in position to furnish large lots of coal tar pitch on advantageous terms. The Gas Light and Coke Co. have a capital of $80,000,000, and have very extensive works at Beckton, below London, on the Thames. Schoellkopf, Hartford & Maclagan have, besides, the output of their Buffalo factory, and are prepared to furnish quotations for North Atlantic or Gulf port points, f. o. b., New York, or carriage paid to any city in the United States or Canada.

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

An experiment will be made with phosphate as a paving material, at Jacksonville, Fla. The rock comes from Bartow, Fla., and is being laid at the expense of Guy R. Pride, a business man of Jacksonville.

An ordinance has been prepared by the committee on streets of the board of public improvements at St. Louis, Mo., to include American bituminous rock, or Kentucky asphalt, in the specifications for asphalt paving, or, to admit material in competition which is not strictly asphaltum, but which comes under that head.

Frank N. Speller, Toronto, Ont., writes that the large asphaltic paving contract in Hamilton, Ont., will be completed this summer. The work was begun in the fall of 1894 and continued until Dec. 5. The effect of the severe winter on this work will be watched with interest, as every possible precaution was taken to insure its safety. Mr. Speller is the expert in charge of the work.

The Merchants' Association, at San Francisco, has engaged Mr. Ernest McCullough as consulting engineer, with a view of investigating the subject of paving the different streets of the city. It is the desire of the association to introduce the best system, and, aside from obtaining the experience of other large cities, it is the intention to pave a number of blocks with different materials and try in that way to reach a conclusion as to the best pavement in point of durability and economy.

An ordinance was recently passed at Chicago, providing for the paving of Langley-ave., and specifying a plank foundation. Later, a petition was presented asking that a stone foundation be used, provided it would not exceed $10 per lot more than plank. The excess cost was estimated by the department of public works at $15, but much surprise was occasioned when the bids were opened and it was learned that stone can be used at an increased cost of between $6 and $7 per lot.

The recent passage of an ordinance providing for brick paving in Seattle, Wash., marks a satisfactory movement for permanent improvement which has been long in demand in that city. Action in this direction has been deferred heretofore because of the need of an adequate water supply and a sewerage system, the acquisition of which exhausted the resources of the city. A material combining all the elements to be considered in paving has been a perplexing subject to the municipal authorities. Planking which has been used heretofore fills so few requirements that it has been considered for sometime merely a temporary necessity until some permanent improvement could be decided upon. The selection of brick as a test seemingly meets with the general approval of the public.

CONTEMPLATED WORK.

Paving has been proposed for Main-st. at Merrill, Wis.

Washington-st., Joliet, Ill., will be paved with brick.

Brick paving has been proposed for the streets at Peru, Ill.

The citizens of Moline, Ill., advocate paving the river road.

Street paving is contemplated for this spring at Monroe, Mo.

The citizens of Hicksville, O., favor the macadamizing of High-st.

The city council at Sandusky, O., has been asked to pave N. Depot-st.

A brick pavement has been suggested for E. College-st. at Oberlin, O.

A petition is being circulated for paving W. North-st. with asphalt at Lima, O.

E. Main and White-sts. will prbably be paved at Urbana, Ill., during the summer.

New-st., from John to Jeroleam-sts., Belleville, N. J., will be macadamized.

Sundry alleys will be paved with granite blocks and macadam at Sacramento, Cal.

An asphalt pavement has been suggested for Sixteenth-st., at Davenport, Ia.

Resolutions have been passed for paving Buchtel-ave. and Forge-st., Akron, O.

An asphaltic pavement will be constructed on Clifford-ave., Indianapolis, Ind.

The city of Macon, Ga., will issue bonds for paving the principal streets of the city.

The town council of Jonesboro, Ind., contemplates paving Main-st. with brick this spring.

An appropriation of $4,000 has been made at Mullica Hill, N. J., for street improvements.

A petition has been circulated at Cleveland, O., for paving Frankfort-st. with asphalt.

The streets of Princeton, Mo., will be macadamized. Bonds have been voted for the work.

The common council at Erie, Pa., has determined to pave Erie-st., from Schuyler to Whitesboro-sts.

A resolution has been introduced at Alexandria, Va., for repaving Pitt and Prince-sts.

The citizens of Athens, Ga., are in favor of paving the streets in the business portion of the city.

The estimated cost of paving Forsyth-st., from Bridge to Cleveland-sts., Jacksonville, Fla., is $15,356.02.

An ordinance has been adopted at Streator, Ill., for paving Hickory-st., from Bloomington to Park.

The property-owners on Meridian-st., Indianapolis, Ind., have voted for a pine or cedar block pavement.

The sidewalks at Provo City, Utah, will be macadamized with mountain gravel at an estimated cost of $1,500.

An ordinance has been passed recommending the paving of Ninth-st., from Union to Elm, at Lincoln, Ill.

Block asphalt has been recommended for paving the floor of the High and Main-st, bridge at Hamilton, O.

Brick pavements have been recommended for Henry, Ross, D'Arcy and Nassau-sts., at Toronto, Canada.

The town of Alfred, N. Y., has been bonded for $8,000 for macadamizing a road between Alfred and Alfred station.

The board of commissioners at Long Branch, N. J., has voted to appropriate $3,000 toward improving Ocean-ave.

Ordinances have been passed at La Grange, Ill., for paving with brick, on macadam foundation, Catherine-ave.

An appropriation of $15,000 has been made by the aldermen at Taunton, Mass., for paving and macadamizing streets.

The principal business streets of Mexico, Mo., will be paved. Plans for the proposed work are about completed.

The common council at Utica, N. Y., has determined to pave Pearl, Broadway, Elm and Hobart-sts. and Taylor-ave.

A resolution passed at Easton, Pa., provides for paving and curbing Twelfth-st., between Northampton and Woods-sts.

The B. of A., Cincinnati, O., has adopted resolutions for paving with brick and granite curbing, eighteen alleys.

A number of streets will be repaved at Albany, N. Y., as follows: N. Pearl and Chapel-sts., Livingston-ave. and Clinton-square.

A movement has been inaugurated at Gainesville, Ga., for the construction of a rock road from Gainesville to Newberry.

A new drive, about a mile in length, will be constructed at East Rock park, New Haven, Conn., at an estimated cost of $2,500.

Specifications have been prepared for paving Wells, Hanna, Lewis and Butler-sts., at Ft. Wayne, Ind. About four miles of alleys will be paved also, with brick.

The business men of Hamilton, O., favor street paving. Nothing definite has been decided upon, however, regarding the matter.

The property-owners on Walnut-st., at Erie, Pa., have petitioned the councils for an asphaltic pavement on concrete foundation.

Action has been taken at Jacksonville, Fla., towards contracting for the proposed paving of W. Bay and W. Forsyth-sts.

An election will be held June 4 in Braddock, Pa., to vote on increasing the debt $25,000 for street, sewer and other improvements.

An ordinance has been recommended for passage ordering a block asphalt pavement for Sassafras-st., from Eighteenth-st. south at Erie, Pa.

A petition has been signed by the citizens urging the passage of an ordinance for macadamizing the Park Heights-ave. at Baltimore, Md.

The city of Lockport, N. Y., has in contemplation the paving of Market and Locust-sts. their entire length. Both asphalt and brick are proposed.

Comptroller Fitch, New York City, has suggested the practicability of repaving Eighth-ave., between Thirteenth and Fifty-ninth-sts., with granite.

The material for the proposed paving of Greenfield-ave., Milwaukee, Wis., has not yet been definitely determined upon, but will be brick, stone or wood.

Surveys are being made for the proposed macadamizing of roads in Northfield, Middletown and Westfield, N. Y., during the spring and summer.

A bill has been passed authorizing Alpena county, Michigan, to vote on the proposition of bonding the county for forty years for $100,000 for roads.

An ordinance passed at Fairmount, Ind., more than a year ago, providing for brick, stone or cement sidewalks on S. Main-st. and Henley-ave., will be enforced.

The public square, Jackson, Washington, Clinton and Main-sts, Franklin, Ind., will be paved with brick. Catterlin-st. will be graveled and the sidewalks paved with brick.

An asphaltic pavement will be constructed on Michigan-st., from E. Water to Broadway, at Milwaukee, Wis. Huron-st. will be paved also, but the material has not been decided upon.

St. Cloud, Minn., contemplates a system of street paving in the near future. A competent person will be engaged to visit different cities for the purpose of inspect-the various kinds of paving.

The estimated cost of the proposed repaving of Atlantic-ave., from Grand-ave. to E. New York, Brooklyn, N. Y., with Belgian blocks is $100,000. Other paving Jamaica to Atlantic-ave., asphalt; Cleve-contemplated is: Barbey-st., from land-st., Schenck and Snediker-aves., Belgian blocks.

N. Main and W. Chestnut-sts. will probably be paved this spring, at Canton, Ill. Petitions have been presented to the council for paving W. Elm-st., and for extending the paving on E. Chestnut-st.

Macadam has been recommended at Seattle, Wash., as a paving material for the lower business district for the reason that it will, in later years, serve as a firm foundation for whatever pavements may be constructed.

L. Vernon Gould, city engineer at Tipton, Ind., writes that the city council has ordered the construction of five blocks of brick pavement, with cement sidewalks. The streets to be improved are in the business portion of the city.

The Quincy & Mt. Sterling road, running through Melrose and Ellington, Ill., will probably be graded and graveled. An appropriation of $1,200 has been asked by the board of supervisors at Quincy to aid in the proposed work.

Ordinances of approval have been recommended at St. Louis, Mo., authorizing the paving of Olive-st., and Taylor, Washington and Page-aves., with asphalt or natural bituminous rock. Delmar-ave. will be paved with vitrified brick.

Brick paving is contemplated at Waverly, Ia. Alderman T. Woodbury, who made a recent visit to Davenport to inspect the pavement of that city, will recommend to the council at Waverly a single course of brick on macadam foundation.

The property owners of S. Seventh-st., between Cook-st. and S. Grand-ave., Springfield, Ill., have circulated a petition asking the city council to order the new paving on that street to be red cedar blocks on a foundation of planks soaked in tar.

The business men of St. Joseph and Benton Harbor, Mich., are interested in a scheme to build a cement bicycle track, five feet wide, from St. Joseph to Chicago, a distance of eighty-one miles. The estimated cost is $2,000 a mile, or $160,000, complete.

The property owners on Grand-ave, Milwaukee, Wis., are divided on the kind of material to be selected for paving that thoroughfare during the summer. Both asphalt and wooden blocks are favored.

The property-owners of Butternut-st., between Salina and Manlius-sts., Syracuse, N. Y., have been served with notices of the proposed paving of that street. Trinidad asphalt, sandstone block, brick and asphalt of a standard quality will be considered. W. Fayette-st., from Salina to West-st., will be paved with asphalt, which will be laid over the present sandstone block pavement.

The board of public works, at Indianapolis, Ind., has ordered paving as follows: Asphalt: St. Clair-st., from Massachusetts-ave. to West-st.; Capitol-ave., from Ohio to Twenty-sixth-st.; Massachusetts-ave., from Bellefontaine-st. to Clifford-ave.; West-st., from New York-st. to Indiana-ave.; Prospect-st., from Reid to Auburn. Brick paving: Maryland-st., from Capitol-ave. to Helen-st.; Kentucky-ave., from union tracks to Eckert-st.; Pearl-st., from Capitol-ave. to Mississippi-st., and from Delaware to Alabama-st. Papers have been ordered prepared for cement sidewalks as follows: First-st., from canal to Indiana-ave.; east side of Meridian-st., from Merrill-st. to Madison-ave.; west side af State-st., from Prospect to Orange-st.; west side of Madison-ave., from Meridian to Union-st. Keith and Louise-sts. will be graveled.

CONTRACTS TO BE LET.

Bids will be received until April 5, at Wooster, O., for improving Bowman-st. and Beall-ave.

Sealed proposals are invited until April 6, Newark, O., for paving First-st., from E. Main to Franklin-sts.

Sealed proposals will be received at Logansport, Ind., until April 15 for a cement sidewalk on Pawnee-st.

Bids will be received at Plattsburg, N. Y., until April 6 for constructing macadam roads at Plattsburg barracks.

Bids are invited at Toledo, O., until April 16 for macadamizing stone road No. 19. A bond of $1,000 will be required.

Bids will be received at Elkhart, Ind., until April 3 for paving, with standard paving brick, Pigeon and Commercial-sts.

Sealed bids will be received until April 5 at Kansas City, Mo., for grading the Lee's summit and Lone Jack road. A cash deposit of $200 will be required on each bid.

Sealed proposals will be received until April 5 at Omaha, Neb., for paving with sheet asphaltum, class B, Jackson and Eighteenth-sts. Each proposal must be accompanied by a certified check for $500.

Sealed bids will be received at Peoria, Ill., until April 4 for paving with brick Spring, Commercial and Liberty-sts. and sundry alleys. Each proposal must be accompanied by cash or certified check for amounts ranging from $100 to $750.

Sealed proposals will be received until April 12, at Springfield, O., for paving W. High-st. with vitrified paving bricks or blocks, or Medina stone blocks, and setting new curbing and resetting old curbing. A bond or certified check for $1,000 will be required.

Bids will be asked during April for pavements of all kinds at Minneapolis, Minn. The paving committee of the city council, accompanied by City Engineer Cappelen and the city engineer of St. Paul, made a recent visit to Salt Lake City, Utah, to inspect the pavement constructed by the American asphalt company of Columbus, O., of Utah asphalt.

CONTRACTS AWARDED.

Sealed proposals will be received until April 6 at Marion, O., for constructing stone sidewalks on Silver-st.

The Rockford construction company, Rockford, Ill., secured the contract for brick paving in districts No. 8 and 9, at Muscatine, Ia. Galesburg brick will be used.

The American bridge and contract company has been awarded a contract for improving the macadam road at Portland, Or.

The board of public works, Seattle, Wash., awarded the contract for paving Pike-st. to James Spurr & Co. for $22,592.20.

The contract for repaving Main-st., Winnipeg, Man., was awarded to Doidge & Co. for $44,027. Cedar blocks, with pine curb, will be used.

The Barber asphalt company, Buffalo, N. Y., secured the contract for paving Falls-st., Niagara Falls, N. Y., at $2.75 per square yard.

The contract for 10,000 lineal feet of Telford paving of the streets of Collingdale, Pa, was awarded to Johnson and Wickersham for $12,000.

The contract for furnishing the city of Macon, Ga., with stone and brick for the ensuing year was awarded to S. J. Blake for $4.75 per thousand.

The contract for paving Franklin-ave., from Spence to Mulberry-st., with vitrified brick, at Scranton, Pa., was awarded to Dunn Bros., at $1.83 per square yard.

The bid of the Rockport granite company for furnishing 300,000 paving blocks to the city of Boston was the lowest received. The bid was $57.90 per thousand.

The contract for brick paving at Waterloo, Ia., was awarded to the Edwards and Walsh construction company of Davenport at their bid of $1.20 per square yard.

Wells, Reichert & Co. of Appleton, Wis., secured the contract for 8,144 square yards of cedar block pavement, 2,560 feet of curbing and 2,700 yards of excavation for $9,839.09 at Menasha, Wis.

Canney Bros. of Minneapolis secured the contract for paving Main-st., Green Bay, Wis., at the following prices: Paving 76 cents per square yard; curbing, 32 cents per lineal foot; paving alleys, 71 cents; curbing, 31 cents; catch basins, $15 each. sewers, 20 cents per lineal foot.

Hennessy & Cox secured the contract for paving Sixth-st., from Sibley-st. to Smith-ave., at Milwaukee, Wis. Asphalt on concrete foundation will be used, except the blocks on the incline between Wabash and Cedar-sts., which will be paved with granite on concrete.

A. D. Thompson, assistant city engineer at Peoria, Ill., writes that bids were opened March 12, for paving sundry streets and alleys. The streets to consist of one course of small bricks on six inches of broken stone concrete foundation, and the alleys to consist of brick on four inches of broken stone concrete foundation. J. J. Jobst of Peoria was awarded the contracts for all the streets, excepting Fifth-ave., at $1.36 per square yard, and at a total cost of $29,914.46. A. Mayfield of Lincoln was awarded the contract for Fifth-ave. at $1.35 per square yard, and at a total cost of $13,734.22.

SEWERS.

The great sub-way drainage system is about completed at Reading, Pa. The work has been one of the most difficult engineering feats ever undertaken in the city.

The board of public works, Bridgeport, Ct., has decided to adopt a kind of pipe for sewers of entirely different material from the ordinary cement, and provided with bell joints. In addition to this spur pipes will hereafter be laid from all sewers to the edge of the sidewalk at regular intervals, thus avoiding the necessity of tearing up streets to make connections.

CONTEMPLATED WORK.

A sewerage system is needed at Luverne, Minn.

A sewerage system is contemplated at Grossdale, Ill.

A sewerage system is contemplated at Alliance, Neb.

A sewerage system is contemplated at Lanesdale, Pa.

A sewerage system is contemplated at Andover, Mass.

A sewerage system has been suggested for Ridgway, Pa.

A sewerage system is contemplated for Manchester, Va.

A system of sewerage is contemplated at Hancock, N. Y.

A sewer will be constructed on Main-st., at Green Bay, Wis.

A sewerage system is contemplated at West Chester, N. Y.

A sewerage system is contemplated at Columbia City, Ind.

A sewerage system is contemplated at Mountain Lake, Minn.

The construction of a sewer is contemplated at Slater, Mo.

The sewerage question is being considered at Kensington, Md.

Sewerage bonds in the sum of $100,000 will be issued at Malden, Mass.

The sewerage system at Bennington, Vt., is in need of improvement.

A sewerage system is being agitated by the council at New Brighton, Pa.

A brick sewer is contemplated for the Seventh-st. district at Wausau, Wis.

A sewer will be built in Butler-st., from Gilmer to Jenkins-sts., at Atlanta, Ga.

A system of sewerage has been proposed for Crawfordsville, Ind., as an imperative need.

Boulder, Col., contemplates issuing $12,000 in bonds for the construction of a sewer.

The proposed plan of sewerage for Kokomo, Ind., has been abandoned for the present.

A 24-inch vitrified pipe sewer has been recommended for Newton-ave., at Superior, Wis.

Bonds in the sum of $20,000 will be issued for sewerage purposes at Bay View, Wis.

The city council of Everett, Wash., has ordered a survey for a complete sewerage system.

A sewerage plan has been adopted for Manchester, Va., which embraces nearly the entire city.

A loan of $250,000 has been authorized at Brockton, Mass., for extending the sewerage system.

A bill has passed the house authorizing Clarksville, Tenn., to issue bonds to extend the sewer system.

The proposed sewerage system for Des Plaines, Ill., is meeting with some opposition from the taxpayers.

A sewer will be constructed in Maple-ave., between Jefferson and Washington-sts., Los Angeles, Cal.

An appropriation of $50,000 has been adopted to defray the expense of a trunk sewer in Derby-st., at Salem, Mass.

The citizens of Irwin, Pa., have petitioned the council for the construction of public sewers on sundry streets.

The board of public works of Milwaukee will recommend the reconstruction of the outlet sewer on Orchard-st.

A bill has been passed by the Kansas legislature providing for the construction of a main sewer in Independence, Kas.

A bill has been passed by the Massachusetts legislature enabling Concord, Mass., to establish a system of sewerage.

A special sewer bill has been passed by the legislature enabling the city of Terre Haute, Ind., to build the proposed belt sewer.

The proposed appropriation of $300,000 for the north metropolitan sewerage system, Boston, has been favorably reported.

Plans have been made at Des Moines, Ia., for a new sewer between Fourteenth and Eighteenth, and School and North-sts.

The board of public works at Sheboygan, Wis., recently recommended the construction of more than seven miles of sewers.

The citizens on Fifth-ave., from Post to Adams-sts., Spokane, Wash., have presented a petition to the council asking for a sewer.

Reconstruction of two or three of the down town sewers is a necessary improvement contemplated for this year, at Omaha, Neb.

F. Herbert Snow, city engineer at Brockton, Mass., writes that contracts will be let in the first part of April for constructing four sections of sewers. About $250,000 will be expended for this work.

A bill has been passed authorizing Fairhaven, Mass., to incur indebtedness for the construction and maintenance of a sewerage system.

C. F. Loweth, C. E., St. Paul, Minn., has been engaged as consulting engineer for the proposed sewerage system of Redwood Falls, Minn.

A bill has been passed by the New Jersey legislature for the construction of sewerage through the Hackensack creek at Hackensack, N. J.

Ordinances were recently recommended at Pittsburg, Pa., for constructing sewers on Lebanon, Mellon, Anderson, Kansas and sundry other streets.

The sewer committee at Montclair, N. J., has been authorized to estimate the cost of sewers and the amount that will be required to complete them.

An appropriation of $185,000 has been asked for at Medford, Mass., to enable the sewer commissioners to carry on the work contemplated for the year.

H. Ward, Binghamton, N. Y., writes that sewers will probably be constructed this season on Chapman, Varick, South, Chestnut and Lydia-sts., and St. John-ave.

The board of public works at Watertown, Wis., deems it necessary to construct sewers during the ensuing year in Fourth, Fifth, Washington and N. Montgomery-sts.

Plans and specifications have been completed at Elwood, Ind., for the converting of Duck Creek into a big sewer. The estimated cost of the proposed sewer is $82,500.

A system of sewerage disposal for the Neponset valley, including the towns of Dedham, Hyde Park, Milton, Quincy and the southerly section of the city of Boston is being considered.

A resolution has been passed at Ft. Wayne, Ind., for the construction of a 15-inch vitrified clay pipe sewer in the alley between Erie and Liberty-sts., and a 12-inch sewer in Harmer-st.

Harvey Linton, city engineer at Altoona, Pa., writes that the result of the election, March 14, was favorable to increase of debt of $280,000 for district sewers and to pay for sewerage disposal plants.

Local sewers will be constructed in Market-st., from New Jersey to East-sts., and in the first alley west of College-ave., from Seventh to Tenth-sts., at Indianapolis, Ind. Sewers are needed in sundry other streets.

Resolutions have been adopted by the town board of East Chester, N. Y., urging the passage of an act for a Bronx Valley sewer from White Plains through Hartsdale, Scarsdale, Tuckahoe, Bronxville, and West Mount Vernon to the Sound.

Preliminary steps have been taken for the construction of a large ditch near Sycamore, Ill., that will drain 1,200 acres of land. The main branch of the ditch will be seven miles long, and three other branch lines, five miles long. The estimated cost is $30,000.

CONTRACTS TO BE LET.

Sealed proposals will be received until April 5 for constructing seven sewers at St. Louis, Mo.

Bids are invited at Champaign, Ill., until April 8 for furnishing material and constructing twenty-seven miles of sewers.

Bids will be received at Green Bay, Wis., until April 5, for constructing a ten-inch vitrified pipe sewer in Main-st.

Sealed proposals will be received until April 6 at Plattsburg, N. Y., for extending the sewer system at Plattsburg barracks.

Bids are wanted at Ft. Shaw, Mont., for the construction of a sewer system at the United States industrial school. The date is not specified for receiving bids.

Sealed proposals will be received until April 11 at Peoria, Ill., for constructing the West Bluff sewer system. Cash deposit or certified check for $20,000 required.

Sealed proposals will be received until April 10 at Cincinnati, O., for constructing sewers and drains in Delhi pike and Fountain-st. Each bid must be accompanied by two disinterested sureties.

Sealed proposals will be received until April 5 at St. Louis, Mo., for constructing sewers in sewer districts Nos. 8, 24, 10, 1, 6 and 7, and in DeBaliviere-ave. A deposit will be required on each contract of amounts ranging from $80 to $605.

CONTRACTS AWARDED.

Davis & Caldwell, Youngstown, O., secured the contract for a large sewer at Monroe, Mich.

The contract for constructing sewers on Ohio, Eighth and Sixth-sts., Quincy, Ill., was awarded to George J. Ebert for $4,793.57.

Adams Bros., who received the contract for the Papoose creek main sewer, at Muscatine, Ia., have begun the work of construction.

The contract for designing a system of public sewers for Rockville, Conn., was awarded to Samuel M. Gray, Providence, R. I., for $14,350.

F. Herbert Snow, city engineer at Brockton, Mass., writes that a contract has been let to Waldo Bros. of Boston for furnishing the city with sewer pipe.

The Dubuque construction company secured the contract for the construction of 300 feet of brick sewer in the Vinton ditch on the West Side at Cedar Rapids, Ia.

Sewer contracts have been awarded at Erie, Pa., as follows: Sassafras-st., south of Second, fifteen-inch tile, J. McCormick & Son, $1 per foot; Twentieth-st., twelve-inch tile, V. D. Eichenlaub, 50 cents per foot; Sassafras-st., south of Nineteenth, J. McCormick & Son, $1 per foot; Fifth-st., twelve-inch tile, E. Driscoll.

The lowest bids received for sewer construction in Detroit, Mich., recently were as follows: Ferdinand-st., 2,280 feet, John Jeynes, $3.68 per foot; Thirty-first-st., 3,338 feet, Buchanan-st. and Thirty-first-st., John Affeld, $2.83 per foot; rebuilding the Hastings-st. sewer, 4,943 feet, John A. Mercier & Co., $4.61 per foot.

WATER-WORKS.

Water works have been suggested for Warren, Ill.

An additional water supply is being considered at College Station, Md.

An extension of water works is contemplated at Howard City, Mich.

An improvement is contemplated in the water system of Braddock, Pa.

The water supply at West Point, Neb., is inadequate for the needs of the city.

A new system of water works will be voted upon at Nebraska City, Neb., in April.

The question of increasing the water supply at Fredonia, N. Y., is being discussed.

Plans and specifications have been prepared for new water works at Weston, W. Va.

The city of Ceredo, W. Va., is ready to grant a franchise for water works construction.

The city of Boston, Mass., has appropriated $65,000 for the protection of the Mystic water supply.

Specifications have been prepared for sinking wells for an additional water supply at South Bend, Ind.

A committee of five has been appointed to reconsider the plans for a new water works system for Troy, N. Y.

H. Ward, Binghamton, N. Y., writes that the board of water commissioners have decided to build a reservoir.

A franchise will shortly be asked of the city council at Lonaconing, Md., for putting in a system of water works.

A bill has been reported authorizing the town of Rutland, Mass., to construct and maintain a system of water supply.

The Kearny citizens' improvement association, P. O. Arlington, N. Y., is discussing means for securing a pure water supply.

Carthage, O., will vote on issuing $15,000 in bonds for the erection of a reservoir and to extend the water and lighting service.

Bills are pending before the Tennessee legislature authorizing Brownsville, Tenn., to issue bonds for the purchase of water works.

The water commissioners of North Brookfield, Mass., have asked for authority to borrow $20,000 with which to extend the water mains.

The plans and specifications prepared by Hiram Phillips, C. E., of St. Louis, for the proposed water works at Quincy, Ill., have been adopted.

The question of water works is being agitated at the following places: Cedar Rapids, Ia.; Hancock, Mo.; Warren, Pa.; Breese, Ill.; Auburn, Ind.; Greenville, Tenn.; Girard, Ill.; Wauseon, O.; Groton, Pa.

A bill has been approved allowing the board of water commissioners of Yonkers, N. Y., to issue $300,000 additional water bonds for the extension of the service.

The city council at Chicago, Ill., passed resolutions recently for an appropriation of $150,000 for the city water plants and the purchase of sites for western stations.

A decree has been rendered by Judge Clark in the United States circuit court appointing William P. Parrish receiver of the Columbia water works, the Columbia gas works and the Columbia electric light company.

A plan is under consideration at Buffalo, N. Y., for increasing the water supply which provides for widening the present tunnel, thus increasing the flow from the river. The purchase of an additional 30,000,000-gallon engine is recommended.

The construction of water works systems is contemplated, as follows: Prattsburg, N. Y.; Malcom, Ia.; Clayton, Pa.; Lancaster, Wis.; Cuba City, Ill.; South Charleston, O.; Millersburg, O.; Hudson, Mich.; Salem, W. Va.; Wesley, Ia.; Albany, Mo.; Princeton, Mo.; Howard City, Mich.; Forestville, N. Y.; Montezuma, Ia.; Marcus, Ia.; Farmersville, Tex.; Spring Lake, Mich.; South Whitley, Ind.; Havensville, Kas.; Bowen, Ill.; Elmwood, Ill.; Amarillo, Tex.; Yellow Springs, O.; Lyndonville, N. H.; Johnson, N. H.; Petersborough, N. H.; Perkasie, Pa.; Sellersville, Pa.; Wyanet, Ill.; Grossdale, Ill.; Hyattsville, Md.; Wellington, O.; Angola, Ind.; Newton, Kas.; Shawano, Wis.; Osborn, O.; Monaca, Pa.; Waterville, Minn.; Alva, Ok. T.; Lewisburg, Tenn.; Shell Rock, Ia.; Sheffield, Ill.; Lancaster, Ill.; Spring Grove, Minn.; Centerville, Ia.; Sherburne, Minn.; Pepperell, Mass.; Oxford, Mich.; Wilmington, Mass.; Indianola, Ia.

CONTRACTS TO BE LET.

Bids are invited until April 4, at Celina, O., for constructing water works.

A contract will be awarded May 1 for putting in a system of water works at Grantsburg, Wis.

Sealed bids will be received at Westville, N. S., until April 15th, for constructing a water works system.

Sealed proposals will be received at Seneca, Kas., until April 9, for the construction of a water works system.

Bids will be received, after May 1, until May 23, at Santa Clara, Cal., for the construction of a system of water works.

Bids will be received at Ft. Shaw, Mont., for the construction of a water system at the United States Indian Industrial School.

The common council at Lakeview, Mich., will receive bids for the construction of a water works system. The date for receiving bids is not specified.

Sealed proposals will be received until April 4 for leasing the water works and furnishing the city of Madison, Ind., with 1,000,000 gallons of water every twenty-four hours for fifteen years.

Bids will be asked soon for the construction of the water works system at El Paso, Tex. Mr. John B. Hawley of Ft. Worth has been engaged to superintend the construction of the system.

CONTRACTS AWARDED.

The contract for constructing the water works system at Port Clinton, O., was awarded to Shaw, Kendall & Co.

The Holly manufacturing company was awarded the contract for furnishing five new pumping engines to Chicago for $275,668.

Snyder & Williams of Dayton secured the contract for constructing a system of water works at Ashland, O., for $44,887.41.

The contract for building the water work conduits at Allegheny, Pa., was awarded to T. R. and R. J. Gillespie for $850,000.

The contract for building water works at Womelsdorf, Pa., has been awarded to Frick, Bradenbough & Co. of Millersburg, Pa.

The contract for constructing the new water works system at Ft. Plain, N. Y., was awarded to Gibney & Orendorff of Indianapolis, Ind.

The city council at Coleman, Tex., awarded the contract for building a system of water works to C. W. Alcott of Dallas for $13,000.

The contract for building the water works system at Converse, Ind., was awarded to Dr. Reuben Murphy of Toledo, O., for $9,700.

A franchise has been granted the Vermillion water, light and power company, Vermillion, S. D., to construct and operate a system of water works and electric lights.

The water commissioners at Brockton, Mass., awarded the contract for furnishing cast iron pipes, 6 to 30 inches, to the McNeal pipe and foundry company at $20.80 per ton.

BRIDGES.

A bridge has been proposed to cross the Frying Pan, near Aspen, Col.

A new stone bridge will be built on Cabot-st., at Holyoke, Mass.

The total amount subscribed for the bridge at Lexington, Mo., is $114,125.

The bill for building a bridge across the river at Sheffield, Ala., has been approved.

A new bridge will be built over the ravine on the West Side, at Niles, Mich.

A new railroad bridge is contemplated across the Buchanan road, near Appleton, Wis.

Bids will be received at Auburn, Ind., until April 16 for the erection of three bridges.

Action is being taken toward securing the proposed high level bridge at Ashtabula, O.

A new bridge will be built on St. Clair-st., over Nine-Mile creek, at Collinwood, O.

A company has been chartered to erect an iron bridge across the river at Sunbury, Pa.

A new bridge will be built by the I., D. & A. across the Wabash at Montezuma, Ind.

A bridge is proposed at Pittsburg, Pa., to cross the Allegheny river in the Nineteenth ward.

The commissioners of Delaware county will build a bridge across White river, near Muncie, Ind.

A new bridge will be built over Turkey run, on the Winchester & Fincastle road, near Winchester, O.

The erection of a bridge is contemplated across the foot of Liberty lake, near Spokane, Wash.

The city council at Waco, Tex., is again agitating the construction of a new bridge over the Brazos river.

The bill for constructing a toll bridge on the Winner bridge piers, at Jefferson City Mo., has been passed.

A concrete culvert 275 feet long will be constructed on Allston way, over Strawberry creek, at Berkeley, Cal.

The estimated cost of the proposed new bridge over Richland creek, on W. Main-st., St. Louis, Mo., is $10,000.

A heavy bridge is contemplated for Gold-st., South Boston, Mass., to take the place of the present small foot bridge.

A bill has been passed appropriating $500 for the purpose of completing a road bridge over Butternut creek, at DeWitt, N. Y.

The commissioner of highways, Richmond, N. Y., has been instructed to build a new iron bridge over the Whitestone brook.

The highway commissioners at Monticello, Ill., have decided to build a bridge in Monticello township across the Sangamon river.

Bids are invited until April 8 at Council Grove, Kas., for the erection of two stone abutments at the Wolff crossing on Gilmore creek.

A bill has been favorably reported for the reconstruction of a part of the Rocks bridge, across the Merrimac river, at Haverhill, Mass.

The construction of a new steel bridge has been ordered over Shoal creek, to replace the present wooden structure, at Montevallo, Ala.

A petition is being circulated at Hillsboro, Ill., asking the city council to adopt an additional appropriation ordinance for building bridges.

The city of Cedar Rapids, Ia., contemplates constructing a foot bridge across the river on the east side of the B., C., R. & N. railway bridge.

Sealed proposals will be received until April 10 at Nashua, N. H., for constructing a stone dam, gates, penstock, bridge, etc., across the Pennichuck brook.

The bridge across the Cedar river at Breckinridge's ferry, Muscatine county, Iowa, will be completed by June 1. The Indiana bridge company has the contract.

The county commissioners of Marion county, Indiana, contemplate the construction of a new steel bridge to replace the gravel road bridge at Broad Ripple, Ind.

A petition will be presented to the city council at Dubuque, Ia., by the residents at Paris, Wis., asking for aid in building a bridge across the Platte river at Garrow's ferry.

A new bill has been drafted at Brooklyn, N. Y., which provides for the construction of a suspension bridge between Broadway, Williamsburg and Grand-sts., New York City.

Sealed proposals will be received until April 16 at Cincinnati, O., for improving W. Eighth-st. by constructing a viaduct superstructure and paving the roadways and sidewalks with asphalt.

The proposed stone bridge across the Tennessee river at the foot of Gay-st., Knoxville, Tenn., will have eight spans and nine piers, four of which are forty feet square and five are 15 by 40 feet. Over each pier are seven small archways.

The plans and specifications for the proposed viaduct on Belknap-st., over the Great Northern tracks, West Superior, Wis., are not satisfactory. The bridge will be too light for the traffic that would pass over it. City Engineer Thomas will insist that the estimate be increased 20 per cent.

The Wrought iron bridge company, Canton, O., secured the contract for building the overhead bridge at Gilboa, O., for $5,000.

The bridge being built across the Cuyahoga river at Columbus-st., Cleveland, O., will be unlike anything ever before constructed in this country. It will be operated by electricity and compressed air, will have a double swing, the halves meeting at a common center and locking. The material will be steel throughout and the electric current will be obtained from street railroad wires. The safety gate, signals, drops and all auxiliary machinery will be operated by compressed air from the bridge house, but the bridge proper will be propelled by electricity.

The plans and specifications for the suspension bridge across the Hudson river, New York City, have been completed by Theodore Cooper, a member of the commission of expert bridge engineers. The bridge will be located at a point between Fifty-ninth and Sixty-ninth-sts., as the secretary of war may approve. It will have a clear span of 3,100 feet. The specifications show a steel wire suspension bridge, stiffened by longitudinal girders extending from tower to tower. The main span will be carried by cables, and the side spans will be carried by viaducts, independent of cables. The towers will

be steel skeleton structures, commencing at an elevation of about 150 feet above high water, where the masonry piers end. Its capacity must sustain 400 pounds per lineal foot for the weight of the rails, ties, guards and foot walks above the longitudinal track girders and the weight of metal in the structure. Besides these the structure shall sustain trains weighing 3,000 pounds per lineal foot upon each of the six tracks, from tower to tower, at rest or moving slowly.

STREET CLEANING.

An appropriation of $25,000 was recently requested of the council at Buffalo, N. Y., by Superintendent O'Shea for cleaning the snow and ice from the streets and sidewalks.

The street-sweeping methods adopted by the Merchants' association at San Francisco have proved successful. The old system of sweeping the streets was imperfect and left the streets so filthy that from $40 to $50 per week was expended in cleaning them. Contracts are now taken for doing the work at two-thirds the former price, and the city has derived much benefit from the new method.

A resolution authorizing Commissioner Johnson to clean the streets until April 1 has been vetoed by Mayor Amos at Syracuse, N. Y., thereby delaying the removal of mud and filth from the streets. Commissioner Johnson maintained that before he could get his street sweepers in order and purchase other necessary implements he should have some assurance that he was to do the work the whole year. The resolution, however, gave to him full authority to expend whatever money was necessary to put his sweepers in order.

PARKS.

A new park is contemplated at Lexington, Ky.

A public park has been proposed for Russellville, Ark.

A public park will be made of Deep Hollow, at Rochester, N. Y.

Loring park, Minneapolis, has been offered to the state as a capitol site.

A stock company has been organized at El Campo, Tex., to establish a park.

Action is being taken at Guthrie, Ok. T., to add the Howe park to the city.

Ionia, Mich., contemplates the purchase of twenty acres of ground for park purposes.

The work of construction will soon beging on the new Starr Garden park at Philadelphia.

Land valued at $250,000 has been donated to the city of Springfield, O., by D. L. Snyder, to be used as a park.

The city of Cambridge, Mass., contemplates the purchase of the whole of the Casino grounds for park purposes.

The eight mile boulevard around the Roger Williams park extension at Providence, R. I., will probably be open to travel next winter.

The park commissioners of Indianapolis, Ind., will take up the Commercial club's plan and lay out extensive parks along Fall creek and White river.

The work of constructing the proposed lake in Carondelet park, at St. Louis, Mo., has been placed in the hands of the Carondelet improvement association.

The citizens of Minnesota and Wisconsin are taking action toward acquiring the Dalles of the St. Croix river, and converting it into an interstate park.

A stock company has been organized at Johnstown, N. Y., which will take under supervision important improvements on the Seymour tract at Sacaudaga park.

The board of trade at Philadelphia has appointed a committee to act with the Women's park association in securing from the city council proper sites for public parks.

The Heine fountain, the work of Hortel, the Berlin sculptor, has been offered the park department of New York City by the German societies, who are anxious to have it placed on the Central park plaza.

Plans for the new street extension, Washington, D. C., have been furnished Mr. Frederick Law Olmstead, who will examine and report upon them. Practically, they show a boulevard laid out all around the city and joining the parks.

The grounds of Schenley park, Pittsburg, are to be enlarged and a lake constructed. A maze will also be established. A pending bill in the state senate gives the city the right of eminent domain in the purchase of property for public uses.

A grand park has been suggested at St. George, N. Y., to be situated in the Clove valley and its surrounding hills behind the Serpentine road. The location is beautiful in its natural state and will require little work to make it requisite.

The report of the park committee appointed to secure sites for new parks for Brooklyn, N. Y., recommends the acquisition of Cypress Hills, Bay Ridge, Ft. Hamilton, Bensonhurst, Canarsie and eight other places in Brooklyn. The total cost of acquiring these properties is estimated at more than $2,000,000.

Frederick Law Olmstead has presented his plans for improving Jackson park, at Chicago. Mr. Olmstead has taken for his key of design the lake view of Jackson park during the world's fair. A number of lagoons will extend in different directions and many small islands will be made around the Wooded island. The drives will have a magnificent sweep. The main drive coming in from Fifty-seventh-st. turns northward of the Field Columbian museum, passing the conservatory, and backing up to Fifty-sixth-st., where it swerves to the southeast in

a broad curve until the lake is reached, when it will follow the beach on the same lines it did during the world's fair. One drive extends eastward, one westward, and one runs along the western side of the park.

STREET LIGHTING.

The city council at Benton Harbor, Mich., proposes to grant a franchise for establishing an electric light plant.

Bids will be received until April 6 at Milwaukee, Wis., for furnishing an electric light and power generating plant for the new city hall.

S. H. Finley, city engineer of Santa Ana, Cal., has submitted plans and specifications for an eighteen-thousand-dollar electric light plant to the board of trustees, which have been approved.

Electric light plants are contemplated for the following places: Bardstown, Ky.; Port Huron, Mich.; Winona, Minn.; Evanston, Ill.; Charlottesville, Va.; Water Valley, Miss.; Lynchburg, Va.; Nebraska City, Neb.; Ovid, Mich.; Sabina, O.

Sealed proposals are invited at Willoughby, O., until April 17, for furnishing the apparatus, appliances, etc., and erecting an electric light and power plant. A certified check is required, in amount equal to 10 per cent. of the gross bid.

STREET RAILWAYS.

An electric road is contemplated at Ellsworth, Mo., to extend to Surry.

O. F. Drake, Austin, Tex., contemplates purchasing electric railway equipment.

An electric road is contemplated at Auburn, N. Y., to extend to Port Byron and Skaneateles.

The Jefferson-ave. railway company, St. Louis, Mo., will change its motive power to electricity.

An electric railway will be built from Cohoes, N. Y., to Dunsbach's ferry by Urban Weldon.

A company has been organized at Greenfield, Mass., to establish an electric road to Turner's Falls.

The work of construction will soon begin on the new electric road from Broadabin to Gloversville, N. Y.

A franchise has been granted the Ballston railroad company, Ballston, N. Y., to operate its line with electricity.

The General Electric railway company has been incorporated and will build and operate an extensive railway system in Chicago.

F. Herbert Snow, city engineer at Brockton, Mass., writes that the Brockton street railway company is preparing to build an electric road to Stoughton, a distance of seven miles.

MUNICIPAL BONDS.

Bids will be erceived July 1 at Sparta, Wis., for $50,000 of 5 per cent. bonds.

Bids will be received until April 5 at Council Bluffs, Ia., for $70,000 of 4½ per cent bonds.

Bids are invited at Coleman, Tex., until April 8 for the purchase of $15,000 of water works bonds.

Sealed bids will be received until April 15 for the purchase of $6,000 of 5 per cent. bonds at Willoughby, O.

Sealed proposals are invited at Crookston, Minn., until April 9, for the purchase of $10,000 of 5 per cent. bonds.